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PART VIII. GOVERNMENTAL DOCTRINE AND COMPARATIVE PRACTICE

Part VIII separates public institutional doctrine from controlled project criteria. Chapter 28 examines United States Department of State terminology, diplomatic-security governance, facility practice and lifecycle control using public sources only. The public record establishes roles, categories and broad obligations. It does not disclose every project threshold or confer approval upon a private design.

Chapter 28. United States Department of State and Diplomatic-Facility Practice

Diplomatic facilities combine sovereign functions, public access, staff workplaces, representational spaces, residences, communications, emergency operations and technical-security systems. Acoustic protection must therefore be coordinated with diplomatic security, overseas building operations, information handling, life safety, host-country conditions, logistics, maintenance and continuity of operations.

The Department of State public framework uses specialised terms for rooms and information systems. Those terms must be preserved as issued. A treated conference room, acoustic conference room, secure room or modular treated conference room cannot be reduced to a generic construction rating. Public definitions and policies inform the engineering architecture, while controlled technical criteria and final use decisions remain with authorised officials.

Figure 28-1. Diplomatic-room assurance links authorised function to controlled criteria, project evidence and a competent-authority decision. Author's original diagram.

28.1 Public authority, terminology and the limits of inference

Department of State public sources define diplomatic-security terms, information-protection responsibilities and specialised room concepts. These definitions matter because they identify institutional function and decision authority. They do not provide a licence to translate every term into a universal acoustic target. [1234]

1 MB-1041. National Institute of Building Sciences, UFC 4-010-05.
2 MB-0426. Construction Specifications Institute, MasterFormat, current issuer information. MasterFormat organises work results but does not define secure-room performance or integration.
3 MB-0883. International Organization for Standardization, ISO 19650-1:2018, ISO 19650-2:2018.
4 MB-0856. International Organization for Standardization, ISO 12999-1:2020, JCGM 100:2008.

Institutional language links rooms to authorised activities, information categories, accreditation or approval processes, communications, construction and continuing control. Similar words used by another government or a commercial manufacturer may carry different legal and operational meaning. Within public authority, terminology and the limits of inference, the decisive analysis follows the complete source-path-receiver chain and records each interface capable of carrying pressure, force, information or measurement bias.

The design basis should cite the exact public definition, edition and date, identify the competent authority and mark any controlled requirement as controlled. Project documents should avoid replacing authority language with marketing terms such as government grade or SCIF equivalent. The design record for public authority, terminology and the limits of inference should translate those mechanisms into dimensions, products, tolerances, support conditions, inspection stages and named ownership.

Source registers should preserve issuer, exact title, revision, public locator, relevant section and limitation. Where a controlled document is acknowledged publicly but unavailable, its existence may be recorded without reconstructing its content. Absence of a public threshold is not permission to invent one. Evidence concerning public authority, terminology and the limits of inference should identify the exact observed unit, method, instrument chain, state, limitations and inference supported.

Worked example 28.1. Terminology control score

A project review examines 20 specialised terms. Fourteen match the governing public source, three are obsolete, two are imported from another jurisdiction and one is undefined. Assign weights 1.0, 0.5, 0.25 and 0 respectively.

C_t is a dimensionless terminology-control screening index. The weights are project management values, not governmental criteria.

The 0.80 score identifies material terminology debt requiring correction before procurement.

The index does not determine compliance or authority. It simply makes source mismatch visible.

28.2 Diplomatic-security governance and responsible roles

Diplomatic security is an institutional system rather than an acoustical discipline. Public policy assigns responsibilities for safeguarding information, controlling facilities, investigating incidents and governing specialised spaces. Engineering teams supply evidence within those roles but do not assume them. [5][6][7][8]

A project may involve the bureau responsible for security, the organisation responsible for facilities, post management, information-technology authorities, fire and life-safety officials, contractors and host-country participants. Their authorities overlap at interfaces but should not be blended into an undefined approval team. For diplomatic-security governance and responsible roles, the mechanism must be traced from excitation through materials, supports, openings, controls and adjoining spaces rather than inferred from the trade name of one component.

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5 MB-1040. National Institute of Building Sciences, Whole Building Design Guide commissioning resources.
6 MB-1041. National Institute of Building Sciences, UFC 4-010-05.
7 MB-0106. ASTM International and listed-system directories for firestop, fire-resistive joint and perimeter-barrier systems.
8 MB-1284. U.S. Department of State, ODNI, NPSA.

The responsibility matrix should identify who owns the protected function, controlled criteria, design, construction surveillance, communications, technical-security review, acoustic testing, acceptance, operations and later change. Delegations and limitations should be explicit. Accordingly, diplomatic-security governance and responsible roles require a controlled configuration with stable identifiers, coordinated details, access provisions and change triggers that remain usable after handover.

Meeting minutes, decisions and waivers should identify the issuing authority and the scope of the disposition. A technical consultant can recommend or verify a condition, but final governmental use remains an institutional act. Professional confidence cannot substitute for authority, and authority cannot transform an unmeasured physical condition. Verification of diplomatic-security governance and responsible roles should combine documentary reconciliation, direct observation and measurement without allowing one evidence class to substitute silently for another.

28.3 Protected function and diplomatic use cases

Diplomatic rooms support negotiations, legal and policy discussions, crisis response, secure communications, briefings and representational meetings. Source level, occupancy, duration, language, remote participation and adjoining access vary markedly. The engineering object must be the authorised use rather than the room name. [9][10][11][12]

A local bilateral meeting may involve moderate speech and controlled access; a crisis cell can include raised voices, multiple displays, remote

9 MB-1123. Project-specific controlled criteria remain with the competent authority and are not reproduced in public procurement documents beyond authorised handling.
10 MB-0856. International Organization for Standardization, ISO 12999-1:2020, JCGM 100:2008.
11 MB-0315. ASTM International, ASTM E90-23.
12 MB-0253. ASTM International, ASTM E336-25a.

audio, frequent entry and twenty-four-hour operation; a representational space may face façades, public circulation and architectural constraints. These states create different source, path and receiver demands; the engineering model for protected function and diplomatic use cases should identify which physical variables change with frequency, operating state, loading, access, maintenance and environmental condition.

Owner requirements should define authorised activities, equipment, vocal states, listener access, operating hours, emergency modes, maintenance and exclusions. Sensitive content need not be disclosed to the design team when consequence and state can be described abstractly. Design development should assign every consequential interface in protected function and diplomatic use cases to a responsible discipline and should resolve acoustic, structural, fire, accessibility and service obligations together.

Acceptance should identify which uses were evaluated and which remain prohibited or conditional. Later mission change requires review rather than silent expansion of the original approval. A room suitable for one diplomatic function is not automatically suitable for every protected activity. The acceptance record for protected function and diplomatic use cases should preserve raw data, calibration, photographs, dimensions, processing and the decision rule needed for later reproduction.

28.4 Treated conference rooms and modular systems

Public State terminology recognises treated conference-room concepts and modular treated conference-room systems. These descriptions indicate integrated protection and institutional purpose, not a single construction recipe. Modular systems introduce repeatable manufacturing advantages but also joints, service interfaces, doors, ventilation and field assembly dependencies. [13][14][15][16]

The performance of a modular enclosure depends on panel connections, seals, floor and ceiling interfaces, doors, HVAC, power, communications, structural support, electromagnetic interfaces and the surrounding host room. A factory test cannot represent every site configuration or later modification. A credible treatment of treated conference rooms and modular systems distinguishes direct transmission, structural coupling, connected air paths, regenerated sound and observational uncertainty before selecting a remedy.

Procurement should require complete reports, configuration identity, installation drawings, interface responsibilities, inspection, field testing, maintenance, spares and change control. The host building must support loads, egress, fire protection, accessibility and environmental conditions. The project documents should make treated conference rooms and modular systems buildable and inspectable by defining geometry, sequence, acceptable variation, substitute evidence and the point at which concealment is prohibited.

Field acceptance should compare the installed module with the tested and approved configuration, exercise operating states and preserve serialised components. The authority decides use after reviewing the complete evidence. Calling a room modular does not make it self-certifying or

13 MB-0897. International Organization for Standardization, ISO 717-1.
14 MB-0315. ASTM International, ASTM E90-23.
15 MB-0253. ASTM International, ASTM E336-25a.
16 MB-0290. ASTM International, ASTM E477-26.

independent of the host building. A favourable observation of treated conference rooms and modular systems remains bounded to the inspected population and measured state, while unseen conditions and untested modes associated with treated conference rooms and modular systems remain explicit limitations.

28.5 Overseas facilities, host conditions and logistics

Diplomatic construction often occurs under overseas procurement, local labour, long supply chains, customs constraints, variable climate and limited replacement support. Materials, workmanship, codes and maintenance practices can differ from the design office assumptions. Secure-room performance is especially sensitive to substitutions and concealed interfaces. [17][18][19][20]

Heat, humidity, dust, salt, seismicity, unreliable power, local fire systems and available skills affect seals, doors, electronics, HVAC and record preservation. Long lead times can encourage emergency substitution. Delivery routes and storage can damage specialised components before installation. Analysis of overseas facilities, host conditions and logistics begins by mapping the actual configuration, because small differences in geometry, restraint, continuity or software state can reverse the dominant path.

The basis of design should identify environmental ranges, local code and host-country interfaces, logistics, secure storage, competent installers, training, mock-ups, remote review limits and spare-parts strategy.

17 MB-0243. ASTM International, ASTM E2964-26.
18 MB-0883. International Organization for Standardization, ISO 19650-1:2018, ISO 19650-2:2018.
19 MB-0882. International Organization for Standardization, ISO 19650.
20 MB-1010. Manufacturer reports are acceptable only when specimen, laboratory, method.

Requirements should be robust without disclosing more protected information than necessary. A robust specification for overseas facilities, host conditions and logistics combines performance language with prescriptive detail wherever the mechanism cannot be verified from a final single-number test.

Construction surveillance should preserve product identity, lot or serial, storage condition, photographs and deviation control. Commissioning should reproduce local climate and power states as far as practicable. A domestic laboratory report does not eliminate overseas installation and environment uncertainty. Testing of overseas facilities, host conditions and logistics should report band data and operating conditions before any summary rating, so that background, flanking, drift and method scope can be examined.

Table 28-1. System, principal mechanism and required evidence.

System	Principal mechanism	Required evidence
Public authority, terminology and the limits of inference	Institutional language links rooms to authorised activities, information categories, accreditation or approval processes, communications, construction and continuing control	Source registers should preserve issuer, exact title, revision, public locator, relevant section and limitation
Diplomatic-security governance and responsible roles	A project may involve the bureau responsible for security, the organisation responsible for facilities, post management, information-technology authorities, fire and life-safety officials, contractors and host-country participants	Meeting minutes, decisions and waivers should identify the issuing authority and the scope of the disposition
Protected function and diplomatic use cases	A local bilateral meeting may involve moderate speech and controlled access	Acceptance should identify which uses were evaluated and which remain prohibited or conditional

System	Principal mechanism	Required evidence
Treated conference rooms and modular systems	The performance of a modular enclosure depends on panel connections, seals, floor and ceiling interfaces, doors, HVAC, power, communications, structural support, electromagnetic interfaces and the surrounding host room	Field acceptance should compare the installed module with the tested and approved configuration, exercise operating states and preserve serialised components
Overseas facilities, host conditions and logistics	Heat, humidity, dust, salt, seismicity, unreliable power, local fire systems and available skills affect seals, doors, electronics, HVAC and record preservation	Construction surveillance should preserve product identity, lot or serial, storage condition, photographs and deviation control
Communications, audiovisual and technical-security integration	A wall-mounted endpoint can bridge an isolated lining, a loudspeaker can exceed the assumed speech source, and a microphone array can create a deliberate electronic capture path	Integrated commissioning should exercise authorised equipment states, preserve configurations and document which disciplines reviewed which functions
Construction surveillance and restricted records	Evidence quality and information security are parallel	Handover should reconcile requirements, drawings, penetration and door registers, images, tests, limitations and authority dispositions
Commissioning, acoustic testing and authority language	The test plan should define source states, rooms, local listener positions, HVAC and masking, doors, electronic equipment, background, methods, instruments, calibration, uncertainty, decision rules and failure response	Commissioning records should be linked to the as-built and as-configured state
Operations, maintenance and continuing validity	The handover baseline should identify boundaries, services, doors, glazing, equipment, software, masking, pressure, test state, limitations, spares and responsible custodians	Authority records should identify conditional approvals, expiry or review triggers and any operational restrictions
Public-source publication boundary	The risk is both security and scholarly error	Technical conclusions should be framed at the strength of public evidence

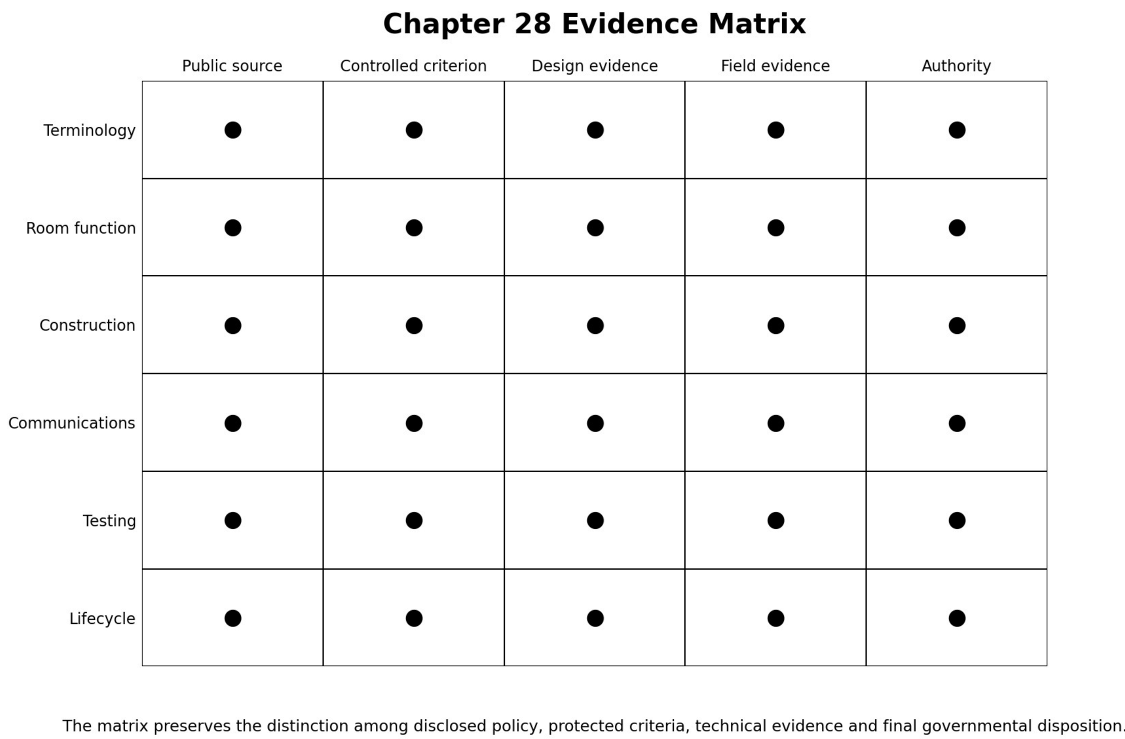

Figure 28-2. The matrix preserves the distinction among disclosed policy, protected criteria, technical evidence and final governmental disposition. Author's original diagram.

28.6 Communications, audiovisual and technical-security integration

Diplomatic rooms commonly depend on secure voice, video conferencing, displays, control systems and protected distribution. Those systems can alter acoustic source level, create penetrations and introduce electronic risks beyond the acoustic scope. Integration must be deliberate. [21][22][23][24]

A wall-mounted endpoint can bridge an isolated lining, a loudspeaker can exceed the assumed speech source, and a microphone array can create a deliberate electronic capture path. Power, grounding, cooling and network routes can bypass the boundary physically. Technical-security and cyber

21 MB-0005. Accredited laboratory status supports competence for specified methods.
22 MB-1253. U.S. Department of Defense, Unified Facilities Criteria and Unified Facilities Guide Specifications relevant to secure construction, acoustics.
23 MB-1284. U.S. Department of State, ODNI, NPSA.
24 MB-1040. National Institute of Building Sciences, Whole Building Design Guide commissioning resources.

controls address different propositions. The controlling behaviour of communications, audiovisual and technical-security integration is system dependent and cannot be reduced to one catalogue value when adjacent construction and services participate in the measured response.

The design should maintain approved equipment inventories, gain limits, mounts, pathways, software, remote support, muting and maintenance. Acoustic, electronic, cyber and communications reviews should share interface data without collapsing conclusions. Procurement and submittal review should preserve the tested or approved identity of communications, audiovisual and technical-security integration, including the features whose alteration would invalidate comparison with the supporting evidence.

Integrated commissioning should exercise authorised equipment states, preserve configurations and document which disciplines reviewed which functions. Changes after acceptance should trigger the appropriate combination of review and retest. A negative technical-surveillance examination does not prove speech containment, and a strong acoustic test does not prove electronic security. Where communications, audiovisual and technical-security integration are evaluated by intervention, the record should describe collateral changes and restoration duties before attributing the observed difference to one mechanism.

28.7 Construction surveillance and restricted records

Secure diplomatic construction requires observation before critical work is concealed, yet photographs, drawings and reports can themselves reveal sensitive facility information. The project must produce enough evidence for authorised review while controlling collection, storage, distribution and retention. [25][26][27][28]

Evidence quality and information security are parallel; a blurred image may protect detail but fail to prove installation; an unrestricted comprehensive model may create unnecessary exposure; stable identifiers and role-based access permit records to remain useful without universal distribution. For the question addressed in section 28.7, construction surveillance and restricted records are examined as a time-varying network whose inputs, boundaries and receiver conditions must all remain explicit.

The surveillance plan should define approved devices, capture permissions, image levels, metadata, transfer, encryption, repositories, redaction, checksums, retention and incident response. Contractors should know which conditions require direct observation and when ordinary quality records are insufficient. For construction surveillance and restricted records, the room data sheet and requirement matrix should state source states, adjoining access, operating modes, lifecycle duties and the accepting authority.

Handover should reconcile requirements, drawings, penetration and door registers, images, tests, limitations and authority dispositions; superseded records should remain controlled and traceable; information restriction must not be used to excuse missing evidence; the proper response is controlled evidence, not no evidence. The dossier for construction

25 MB-0243. ASTM International, ASTM E2964-26.
26 MB-0039. American Society of Heating, Refrigerating and Air-Conditioning Engineers and recognised mechanical-system guidance, used for commissioning and operational-mode coordination.
27 MB-1010. Manufacturer reports are acceptable only when specimen, laboratory, method.
28 MB-0883. International Organization for Standardization, ISO 19650-1:2018, ISO 19650-2:2018.

surveillance and restricted records should distinguish as-designed, as-submitted, as-installed, as-tested, as-authorised and as-operated states.

28.8 Commissioning, acoustic testing and authority language

Diplomatic-facility testing should begin with the proposition to be supported. Laboratory assembly evidence, installed field performance, occupied speech-security assessment and final authority acceptance are distinct. Public State policy establishes governance but does not replace project-specific test planning. [29][30][31][32]

The test plan should define source states, rooms, local listener positions, HVAC and masking, doors, electronic equipment, background, methods, instruments, calibration, uncertainty, decision rules and failure response. Maximum credible vocal or electronic conditions may be more demanding than routine speech. The physical inquiry into commissioning, acoustic testing and authority language separates what carries energy from what merely appears defective, thereby preserving alternative hypotheses until discriminating evidence is obtained.

Reports should state observed quantities and limitations precisely. Terms such as passed, approved, accredited and secure should be used only by the role authorised to make that decision. Technical reports can recommend conditions and identify residual risk. The design team should provide maintainable routes, inspection access and authorised replacement criteria

29 MB-0882. International Organization for Standardization, ISO 19650.
30 MB-1176. The complete issuer, edition, status.
31 MB-1123. Project-specific controlled criteria remain with the competent authority and are not reproduced in public procurement documents beyond authorised handling.
32 MB-1253. U.S. Department of Defense, Unified Facilities Criteria and Unified Facilities Guide Specifications relevant to secure construction, acoustics.

so that later work on commissioning, acoustic testing and authority language does not silently alter the boundary.

Commissioning records should be linked to the as-built and as-configured state. Any adjustment made during testing must be recorded and either incorporated into the baseline or reversed. A favourable test result does not retrospectively prove every concealed detail or authorise use outside the tested state. Inspection and measurement of commissioning, acoustic testing and authority language should be scheduled while the controlling condition is still observable, with missed hold points treated as missing evidence rather than acceptance.

28.9 Operations, maintenance and continuing validity

Diplomatic facilities operate for years under staff turnover, security incidents, equipment refresh, local repairs and changing missions. Doors wear, seals age, cables are added, conference systems update and HVAC is rebalanced. Continuing validity depends on governance of those changes. [33][34][35][36]

The handover baseline should identify boundaries, services, doors, glazing, equipment, software, masking, pressure, test state, limitations, spares and responsible custodians. Maintenance instructions must preserve mechanisms rather than merely appearance. Emergency work should trigger retrospective reconciliation. Evaluation of operations, maintenance

33 MB-1044. National Institute of Building Sciences, Whole Building Design Guide, public resources on project planning.
34 MB-0005. Accredited laboratory status supports competence for specified methods.
35 MB-1123. Project-specific controlled criteria remain with the competent authority and are not reproduced in public procurement documents beyond authorised handling.
36 MB-0883. International Organization for Standardization, ISO 19650-1:2018, ISO 19650-2:2018.

and continuing validity requires a scale-appropriate model, from local joint or support behaviour through room-level and whole-building consequences.

Periodic assurance should combine user checks, technical inspections, asset reconciliation, masking and background monitoring, doorset maintenance and event-driven acoustic retesting. Incident response should protect information and evidence without premature attribution. Details governing operations, maintenance and continuing validity should be coordinated in three dimensions, with movement, supports, penetrations, terminations and control states shown rather than left to site improvisation.

Authority records should identify conditional approvals, expiry or review triggers and any operational restrictions. Lessons learned should alter specifications, training and controls at an abstract level suitable for broader use. A room does not remain valid merely because its original acceptance certificate remains in a file. Reports on operations, maintenance and continuing validity should separate observation, calculation, interpretation, residual alternatives and competent-authority disposition.

28.10 Public-source publication boundary

A public engineering monograph can explain acoustic physics, evidence structures, project delivery and the disclosed institutional framework. It should not reconstruct hidden thresholds, unpublished room details, facility-specific vulnerabilities or protected operational procedures from scattered fragments. [37][38][39][40]

37 MB-1040. National Institute of Building Sciences, Whole Building Design Guide commissioning resources.
38 MB-1044. National Institute of Building Sciences, Whole Building Design Guide, public resources on project planning.
39 MB-0882. International Organization for Standardization, ISO 19650.
40 MB-0856. International Organization for Standardization, ISO 12999-1:2020, JCGM 100:2008.

The risk is both security and scholarly error; a plausible inferred criterion may be obsolete, context dependent or simply wrong; repetition across unofficial sources does not convert it into authoritative doctrine; controlled information should remain with authorised holders. The mechanism associated with public-source publication boundary should be stated in measurable terms, including the quantities, directions, frequency bands and operational states that could control the result.

Publication should identify source status, distinguish quotation from interpretation, use exact titles, preserve superseded history where relevant and state where the public record ends. Case examples should be synthetic or sufficiently abstracted. The selected treatment of public-source publication boundary should remain effective under credible extremes, not merely under the convenient condition used for an early demonstration.

Technical conclusions should be framed at the strength of public evidence. The work can recommend a disciplined process without pretending to publish the complete governmental specification. Refusal to guess is a mark of professional rigour, not a deficiency in analysis. A result for public-source publication boundary cannot be extended automatically to another room, product, geometry, season or software state without an explicit equivalence analysis.

28.11 Statutory foundation and the public authority chain

Diplomatic-facility security begins with statutory responsibility rather than with an acoustic product or consultant's specification; public law places security functions with the Secretary of State and provides the institutional basis for protecting missions, personnel, communications and operations. The engineering consequence is a traceability obligation; every room-level requirement should be connected to an authorised function, an issuing authority, a project document, an observable condition and a decision record; a chain that begins only with a vendor brochure or an inherited drawing has no reliable legal or institutional foundation, even when the physical detail appears competent.

The public statute remains deliberately broad. It does not disclose controlled technical thresholds, identify every internal approval, or convert a field measurement into governmental authorisation. The technical team should therefore distinguish four records: the public authority establishing responsibility, the controlled criterion supplied through authorised channels, the project evidence demonstrating the installed state, and the final institutional disposition. These records can be linked without being merged. A report may show that a stated measurand was obtained with stated uncertainty, while expressly reserving use approval to the competent authority and excluding untested electronic, optical, cyber or insider pathways.

Traceability should also distinguish authority from applicability. A statute or policy may govern the Department generally while a particular project falls within a narrower programme, facility category, geographic condition or tenant arrangement. The applicability memorandum should identify the project facts that activate each source and should record contrary or overlapping authorities. That memorandum becomes particularly important when a leased facility, temporary compound, residence or interagency tenant does not resemble the programme's ordinary purpose-built case. Engineering assumptions should then be framed as conditional statements, not universal rules. A requirement is controlling because an authorised role applied it to the named project, not merely because a public document exists. Changes in ownership, mission, information category, adjoining access or building work can reopen applicability. The lifecycle register should therefore retain the original determination, later amendments and the evidence used to decide that the project remains within the authorised envelope.[41]

Worked example 28.2. Authority-traceability coverage

A requirement register contains 40 consequential requirements. Thirty-four identify an authorised source, responsible owner, verification method and accepting role. Six contain only descriptive text. Calculate the traceability coverage.

C_a is the dimensionless authority-traceability coverage, N_l is the number of fully linked requirements, and N_t is the total consequential requirement count.

Coverage is 85 per cent, leaving six requirements institutionally incomplete. The project-defined screening value does not establish legal compliance or technical adequacy. It identifies records requiring resolution before design freeze.

Table 28-2. Public authority and project-evidence chain.

Layer	Controlling question	Representative record	Prohibited substitution
Statutory authority	Who holds the public responsibility?	United States Code and public Department policy	Vendor or consultant authority
Controlled criterion	What protected requirement governs the project?	Authorised criterion and interpretation	Inference from public fragments

41 MB-1176. The complete issuer, edition, status.

Layer	Controlling question	Representative record	Prohibited substitution
Engineering evidence	What physical state was designed, installed and measured?	Drawings, inspections, raw data and uncertainty	Governmental approval language
Institutional disposition	What use is permitted under what conditions?	Accreditation, approval or use decision by authorised role	Automatic extension to other rooms or states

28.12 Chief of Mission, Diplomatic Security, OBO, post, and interagency responsibility

A diplomatic project crosses organisational boundaries. Diplomatic Security governs security programmes and specialised technical-security functions; OBO delivers and manages real property; the Chief of Mission and post leadership govern mission operations within their authorities; information-technology, communications, fire, life-safety, medical, consular and tenant organisations may control equipment or use states that materially affect the room. The useful project instrument is not a generic list of stakeholders, but a responsibility matrix that assigns each consequential decision to one accountable role and identifies consultation, review, implementation and evidence duties.

Overlap is inevitable, but ambiguity is not; a security reviewer may define a controlled performance requirement, while an acoustical engineer designs and measures the physical response; OBO may control the construction contract and facility baseline, while post personnel control daily door, HVAC, conference-system and maintenance states. An interagency occupant may own the protected function without owning the building; these distinctions should remain visible in submittals, hold points, tests and change requests. Where two authorities appear to conflict, the team should escalate the conflict rather than selecting the easier instruction or inventing a blended approval.

Decision pathways should be tested through realistic project events. A designer proposing a new penetration needs to know which office confirms the controlled criterion, who approves the architectural and engineering response, who observes installation, who accepts the test evidence and who updates the operational baseline. A maintenance supervisor discovering water damage needs a shorter emergency path with clear stop-use authority and later reconciliation. These pathways should be rehearsed before construction or occupancy. Contact lists, alternates, time-zone coverage and escalation thresholds matter in overseas work, where the responsible office may be several hours away and the local contractor may be waiting at an open boundary. The matrix should also distinguish advice from direction. A meeting participant can contribute expertise without possessing approval authority. Minutes should name the decision, issuer, scope, evidence considered and any condition or expiry, so that later reviewers do not infer approval from attendance alone.[42]

Worked example 28.3. Weighted responsibility coverage

Ten project duties are assigned weights reflecting consequence. Eight are fully assigned, one is partly assigned and one is unassigned. The total available weight is 24. Fully assigned duties contribute 19, the partial duty contributes 1.5, and the unassigned duty contributes zero.

C_r is weighted responsibility coverage, w_i is the consequence weight for duty i, and c_i is its completion factor from zero to one.

42 MB-0005. Accredited laboratory status supports competence for specified methods.

Weighted coverage is 85.4 per cent. The result does not decide whether the remaining gap is tolerable. A single unassigned high-consequence duty can still block construction, testing or use.

Figure 28-3. Treated and modular treated conference-room concepts depend on host-structure, HVAC, power, data, fire, egress, accessibility, configuration, assembly, testing and lifecycle interfaces. Author original diagram.

28.13 SECCA collocation, setback, waivers, and acoustic relevance

The Secure Embassy Construction and Counterterrorism Act and associated Department policy shape diplomatic-facility planning through collocation, setback and security governance; those concepts principally address broader physical-security risk; their acoustic relevance is indirect but substantial; site geometry affects public access, neighbouring occupancy, façade exposure, traffic noise, emergency routes, utility entry and the distance between a protected source and an accessible receiver. A favourable setback may reduce one external listening opportunity while doing nothing to control an internal duct, structural junction or adjoining tenant.

Waivers and exceptions require precise language. A statutory waiver, an exception to an OSPB standard, a design deviation, a construction nonconformance and an acoustical test failure are not interchangeable. Each has a different authority, evidentiary basis, duration, mitigation burden and closure route. Acoustic engineers should supply bounded physical evidence where relevant, but should not describe an engineering workaround as a governmental waiver. Mitigation must be inspectable, assigned, tested under the relevant state and linked to the formal disposition that permits occupancy or continued use.

Mitigation tracking should connect physical and administrative controls. Increased standoff, restricted access, guard presence, masking, operating-hour limits, room relocation and construction repair can each reduce a different part of the risk model. Their effectiveness, however, depends on continued availability and enforcement. A control that exists only during the commissioning visit should receive no lifecycle credit. The disposition record should specify the mechanism addressed, responsible owner, verification frequency, failure indication, contingency and reopening trigger. Where several controls are credited together, common-cause failure should be considered. Loss of power can disable masking, access control and monitoring simultaneously. A landlord action can alter both adjacency and service routing. The acoustic analysis should not assign independent probabilities to controls that share one vulnerable dependency. A conservative assessment may require the authority to treat the dependent controls as one layer until independent evidence supports separation.[43]

Worked example 28.4. Mitigation verification fraction

A formal disposition identifies twelve mitigation actions. Ten have been installed, tested and documented. One is installed but untested, and one is not installed. Calculate the fully verified fraction and the broader installation fraction.

M_v is the verified fraction, M_i is the installed fraction, N_v is fully verified actions, N_i is installed actions, and N_r is required actions.

43 MB-1178. The final acceptance dossier must distinguish as-designed, as-submitted, as-built.

The project is 91.7 per cent installed but only 83.3 per cent verified. Treating those values as equivalent would conceal an untested protection and an absent protection.

28.14 OSPB standards, controlled criteria, and the public-source boundary

Public Department policy acknowledges the Overseas Security Policy Board standards and the roles through which they are applied; the standards themselves can contain controlled detail; a public monograph may explain that controlled criteria govern a project, describe the evidence architecture needed to demonstrate compliance, and distinguish physical mechanisms. It should not reconstruct thresholds from procurement fragments, obsolete manuals, photographs, unofficial recollections or comparisons with another jurisdiction; a guessed value can be both a security problem and a serious engineering error.

The practical solution is a two-layer specification; the public layer defines ordinary engineering matters such as variables, units, specimen identity, calibration, uncertainty, traceability, life safety, maintainability and record control; the controlled layer contains the protected criterion, authorised interpretations and project-specific restrictions. Cross-references permit the layers to work together without placing sensitive values in broadly distributed drawings; the publication record should state where public support ends, who holds the controlling requirement, and which conclusions remain impossible without authorised access.

Controlled criteria should be referenced through stable identifiers rather than paraphrased into uncontrolled prose. A public specification can require compliance with the authorised controlled document, identify the responsible reviewer and describe ordinary quality evidence, while the protected annex supplies values and restricted interpretations. The project team should prevent the controlled identifier from becoming detached from its revision. A test plan based on one edition and a construction detail approved under another can produce an apparently complete but internally inconsistent record. Access limitations should be planned into workflow. Personnel without controlled access may still prepare geometry, fire, structure, commissioning logistics and uncertainty models, provided an authorised reviewer verifies that the public work satisfies the protected requirement. The interface record should show the review occurred without reproducing the protected content. This permits disciplined collaboration while preserving the source boundary.[44]

Worked example 28.5. Public-source sufficiency screen

A public analysis requires evidence for 25 propositions. Eighteen are fully supported by public primary sources, four can be stated only at a general level, and three depend on controlled criteria and must be withheld. Assign factors 1, 0.5 and 0.

P_s is the public-source sufficiency screen, N_f is fully supportable propositions, N_g is general-only propositions, and N_t is total propositions.

The public treatment can responsibly develop 80 per cent of the weighted proposition set. The remaining material must be bounded or withheld, not guessed.

44 MB-0856. International Organization for Standardization, ISO 12999-1:2020, JCGM 100:2008.

28.15 Diplomatic facility taxonomy and use-state classification

Diplomatic property includes purpose-built compounds, office buildings, leased floors, residences, warehouses, consular spaces, representational rooms, temporary facilities and specialised technical spaces; the same room title can conceal radically different boundary conditions; a conference room inside a new embassy compound may have controlled circulation and integrated services. A leased office can share slabs, façades, risers and management access with unrelated occupants; a residence may combine protected discussion with domestic systems, visitors and irregular maintenance. Taxonomy therefore begins with ownership, control, access, structural continuity, service sharing and operating authority.

Use classification is equally important. Routine policy discussion, crisis coordination, remote conferencing, classified or otherwise protected conversation, legal consultation, medical discussion and public diplomacy create different source states and consequence. The room data sheet should identify authorised uses, prohibited uses, source equipment, occupancy, duration, languages, adjoining access, after-hours conditions and emergency states. Classification should be reviewed whenever the mission, tenant, technology or host building changes. A historical room label cannot substitute for a current use-state definition.[45]

Worked example 28.6. Credible state-combination count

A room has three authorised use classes, two vocal-source states, four adjoining-access states and three building-system states. Before screening physical impossibilities, calculate the full state count.

45 MB-1040. National Institute of Building Sciences, Whole Building Design Guide commissioning resources.

N_s is the state-combination count. N_u, N_v, N_a and N_b are the counts for use, vocal source, adjoining access and building systems.

Seventy-two combinations require rational screening. The count does not mean every state needs a full test. It shows why an undefined phrase such as normal operation is inadequate.

Table 28-3. Diplomatic facility and use-state taxonomy.

Context	Typical control condition	Acoustic-security concern	Required classification evidence
Purpose-built compound	Managed site and integrated infrastructure	Internal adjacencies, shared services and lifecycle scale	Site, room, access and system state
Leased office	Mixed ownership and landlord systems	Shared slabs, façades, risers and maintenance access	Lease control, host drawings and due diligence
Residence or representational space	Mixed official, domestic and visitor use	Irregular access, furnishings and service states	Authorised use, occupancy and operating restrictions
Temporary facility	Compressed schedule and limited permanence	Modular interfaces, logistics and reduced evidence opportunity	Configuration, duration, compensating controls and expiry
Specialised technical room	Controlled equipment and institutional process	Multi-domain interfaces and authority language	Exact designation, approving role and lifecycle baseline

28.16 Controlled access areas and room-boundary interfaces

A controlled access area is an institutional security boundary, while an acoustical enclosure is a physical transmission system; they may coincide, overlap or diverge; a protected room can sit inside a larger controlled zone, allowing some leakage to remain within authorised access. Conversely, one wall may border a corridor, service space or host-building area with materially different access; the acoustic model should therefore map the actual receiving zones, not merely the administrative colour on a plan.

Interfaces control performance. Doors, glazing, transfer air, ducts, cable sleeves, raised floors, suspended ceilings, structure, drains and access panels can connect the source room to spaces beyond the intended boundary; the penetration register should identify which administrative boundary each path crosses, who can reach the receiving side, and which states alter that access. A change to access control can increase acoustic consequence without changing a decibel; a change to construction can increase acoustic transmission without changing access authority; both variables belong in the acceptance model.

Administrative zones should be modelled over time. A corridor may be controlled during working hours but opened to cleaners, maintenance staff or emergency responders later. A roof may be normally locked yet accessed during storm repair. A neighbouring leased suite can change tenant. The access model should identify routine, exceptional and foreseeable temporary states, including the duration and supervision of access. Measurements can then target credible high-consequence combinations rather than one convenient occupancy snapshot. The model should also distinguish direct listening access from the ability to place or maintain equipment. A transient passer-by, a worker with prolonged unsupervised access and a remote receiver connected through a service route present different exposure conditions. This analysis remains threat-informed and should be bounded to lawful public methodology. Facility-specific adversary assessments and controlled countermeasures remain with authorised security personnel.[46]

46 MB-1176. The complete issuer, edition, status.

Worked example 28.7. Geometric open-area screening

Three unsealed sleeves each have an effective open area of 180 square millimetres. The protected boundary has an area of 42 square metres. Calculate the aggregate geometric opening fraction.

A_o is aggregate effective opening area, A_b is boundary area, and f_o is the dimensionless opening fraction.

The opening fraction is about 0.00129 per cent. A tiny geometric fraction can still dominate a high-isolation boundary. The calculation does not predict transmission through sleeves, cables or firestop systems.

28.17 ACR, TCR, MTCR, BCR, SCR, and terminology transition

Department terminology differentiates room concepts by institutional function and protective architecture; the public definitions identify acoustic conference rooms, treated conference rooms, modular treated conference rooms, built-in conference rooms, secure conference rooms and secure rooms in specialised contexts. The terms should be quoted and dated because programmes evolve; public definitions state that acoustic conference rooms are no longer procured and that treated concepts include broader protection; that history matters when auditing legacy facilities, drawings, asset records and maintenance instructions.

Terminology transition creates configuration risk. A legacy room may retain an obsolete label although its construction, communications and authorised use have changed. A procurement team may use a familiar abbreviation for a modern module that carries different interfaces and approval. The asset register should therefore preserve original designation, current authoritative designation, installation date, configuration identifier, approving office and known limitations. Conversion should never be performed by search-and-replace alone. The physical room and its authority record must be reconciled.[47]

Worked example 28.8. Terminology reconciliation rate

A portfolio review identifies 30 specialised rooms. Twenty-two labels match current definitions and records, five are legacy labels with resolved equivalence, and three remain unresolved. Calculate the resolved rate.

C_t is terminology reconciliation, N_c is current matches, N_l is resolved legacy labels, and N_p is the portfolio count.

Ninety per cent is reconciled, but the three unresolved rooms require controlled review before their labels are used to infer capability or authorised use.

Table 28-4. Specialised room terminology and configuration controls.

Term class	Public meaning or transition	Configuration record	Inference to avoid
ACR	Legacy acoustic conference-room term; no longer procured under current public definition	Original installation, current use and limitations	Equivalence to a modern treated room
TCR	Treated conference-room concept with integrated protective purpose	Exact configuration, services and authority	Single acoustic construction rating
MTCR	Modular second-generation treated enclosure concept	Module identity, host interfaces and field evidence	Factory result as complete site acceptance
BCR or SCR	Specialised built-in or secure conference-room terminology under applicable authority	Controlling definition and project records	Universal meaning outside its issuing framework

47 MB-1178. The final acceptance dossier must distinguish as-designed, as-submitted, as-built.

Term class	Public meaning or transition	Configuration record	Inference to avoid
Secure room	Institutional term requiring governing context	Authorised use, criteria and approval	Marketing use of the word secure

28.18 Emanations countermeasures and acoustic or RF non-equivalence

Public organisational descriptions assign Department specialists responsibilities for emanations countermeasures, shielded enclosures, secure conference spaces and related technical-security review; those responsibilities show that specialised rooms are multi-domain systems; acoustic attenuation concerns pressure, structure-borne vibration and speech recovery. Radio-frequency attenuation concerns electromagnetic coupling, shielding continuity, apertures, bonding and equipment emissions; Cyber protection concerns code, identities, networks, data and control. A favourable result in one domain cannot be converted into a result in another.

Integration is still essential because the domains share physical interfaces; a ventilation waveguide, cable filter, door, modular seam or conductive gasket can have acoustic, electromagnetic, fire, structural and maintenance consequences; a remediation that adds an acoustic lining may obstruct inspection or change shielding access. A cable added for conferencing can alter both acoustic sealing and electromagnetic configuration; the design review should use a domain-interface matrix that records each shared element, controlling authority, evidence, maintenance rule and change trigger. The public report should describe interaction without exposing protected thresholds.

Shared-interface review is most effective when performed against actual construction details. A conductive door threshold can satisfy an electromagnetic continuity objective while creating a hard structural bridge or limiting the compressible geometry available to an acoustic seal. A honeycomb vent can support airflow and electromagnetic attenuation but create a duct-borne acoustic path or regenerated noise. A filtered cable panel can concentrate penetrations and improve control while producing a mechanically stiff connection. Each detail should be reviewed by the responsible disciplines with one coordinated section, installation sequence and maintenance method. Testing should also be domain aware. An acoustic source may interfere with electronic equipment or alarms. An electromagnetic test configuration may require doors, cables or power states that differ from acoustic commissioning. The test matrix should record those differences and prohibit cross-domain extrapolation unless an equivalence analysis demonstrates that the relevant physical state is unchanged.[48]

Worked example 28.9. Weakest-domain screen

Project-defined assurance scores are 0.94 for acoustic evidence, 0.88 for electromagnetic evidence, 0.91 for cyber configuration and 0.97 for life-safety coordination. Calculate the weakest-domain screen.

A_min is a project screening value. The component scores represent evidence completeness, not governmental compliance.

48 MB-0106. ASTM International and listed-system directories for firestop, fire-resistive joint and perimeter-barrier systems.

The electromagnetic evidence controls the screen at 0.88. Averaging the domains would conceal the weakest record. No score establishes security across domains.

28.19 Protected speech source-state register

Diplomatic speech sources vary from quiet bilateral conversation to raised crisis coordination, interpretation, briefings, media playback and electronically reinforced remote participants. The source-state register should identify level, spectrum, directivity, position, duration, duty cycle and control setting. It should also distinguish human voice from loudspeaker output. An audiovisual system can exceed ordinary vocal levels, reproduce repeated high-consequence content and aim energy toward a consequential partition or façade.

Source selection affects every downstream conclusion. A field test using one omnidirectional loudspeaker position can characterise a method-defined room relationship, but it may not represent a standing presenter, a table microphone and loudspeaker loop, or a wall-mounted display with built-in speakers. The commissioning plan should include representative and challenge states, then state which is controlling by frequency and receiver. Confidential content is unnecessary. Phonetically balanced material, numbers, names and synthetic signals can test consequence without disclosing operational information.[49]

49 MB-1253. U.S. Department of Defense, Unified Facilities Criteria and Unified Facilities Guide Specifications relevant to secure construction, acoustics.

Worked example 28.10. Logarithmic combination of two source states

Two independent loudspeakers produce 72 dB and 69 dB at a boundary reference position. Estimate the combined level when their outputs are incoherent.

L_sum is combined sound-pressure level. L_1 and L_2 are individual levels under the same reference conditions.

The combined level is approximately 73.8 dB, 1.8 dB above the stronger source. Coherent signals, room modes, limiting and directionality can change the result.

28.20 Adjoining-access and receiving-zone model

The receiving side of a diplomatic room is not one uniform space. It can include controlled corridors, private offices, public circulation, plant rooms, ceiling voids, roofs, façades, leased premises, grounds and neighbouring property. Access changes by time, maintenance activity, host-building practice and emergency condition. The receiving-zone model should identify who can be present, how long they can remain, what equipment they may carry, whether the location is observable and which building states make the path stronger or the background quieter.

Measurements should be spatially and operationally aligned with that model. A room-average receiving value can miss a local door-jamb, grille, façade or structural point. A daytime survey can miss a quiet night state. Conversely, a spectacular local level in an inaccessible locked plenum may have less immediate consequence than a modest level at a public seating position. Engineering and access evidence should be reported separately and then combined through an explicit consequence model. Neither a security badge nor an acoustic number should silently substitute for the other.[50]

Worked example 28.11. Receiving-zone coverage

A survey plan identifies 18 consequential receiving zones. Fifteen were measured in all controlling operating states, two were measured only during daytime, and one was inaccessible. Calculate complete coverage.

C_z is complete receiving-zone coverage, N_c is zones fully examined, and N_z is the consequential zone count.

Complete coverage is 83.3 per cent. The result must be reported with the three unresolved zones. It is not legitimate to describe the room as fully surveyed.

28.21 OBO capital-project lifecycle and integrated design review

A diplomatic capital project proceeds through need definition, site selection, programming, design, procurement, construction, commissioning, occupancy and lifecycle management. Acoustic security must enter before geometry and services harden. A late requirement can force compromised door locations, difficult duct routes, congested ceilings or expensive modular remedies. Early integration permits source and receiver zones, structural discontinuities, plant locations, access routes, life safety and maintainability to be considered as one system.

Integrated design review should test not only whether drawings contain an acoustic note, but whether requirements survive across disciplines and

50 MB-0039. American Society of Heating, Refrigerating and Air-Conditioning Engineers and recognised mechanical-system guidance, used for commissioning and operational-mode coordination.

project stages; the review record should identify unresolved interfaces, responsible owner, due date, closure evidence and impact on controlled criteria. Repeated review comments may signal a weak design process rather than mere administrative delay; closed comments require proof in the current model or specification; they should not vanish because a drawing set advanced to the next issue.

Programme gates should align with the increasing cost of change. Before site commitment, the project can alter adjacency and access. During concept design, it can establish room location, massing, structural breaks and plant strategy. During design development, it can coordinate doors, glazing, ducts, services and modules. After procurement, many choices become substitutions or rework. The decision register should therefore identify which questions must close at each gate and the consequence of deferral. A deferred item should carry an owner, funding, schedule effect, interim assumption and last responsible decision point. Review quality also depends on model maturity. A comment resolved against an obsolete drawing is not closed. Automated coordination can identify geometric clashes, but it cannot determine whether a shared support, access panel or control state violates the protected concept; human technical review remains necessary at the interfaces where mechanism and authority meet.[51]

Worked example 28.12. Design-review closure rate

An integrated review records 64 consequential comments. Fifty-two are closed with verified evidence, seven are responded to but not verified, and five remain open. Calculate verified closure.

51 MB-1159. Society of Fire Protection Engineers, NFPA and listed-system sources, used for fire and life-safety interface coordination within their stated scopes.

C_d is verified design-review closure, N_v is verified closed comments, and N_c is consequential comments.

Verified closure is 81.25 per cent. Responses without evidence remain open for release purposes, especially where they affect a protected boundary or future test access.

28.22 Basis of design, room data sheets, and requirements traceability

The basis of design translates authorised use into engineering assumptions. It should name the protected functions, source states, receiving access, applicable public and controlled authorities, acoustical measurands, system states, life-safety constraints, maintainability, test methods and decision process. A room data sheet then converts those assumptions into location-specific geometry, doors, glazing, services, equipment, adjoining spaces, operating modes and evidence requirements. Generic security notes are too remote from the actual room to control procurement and construction.

Requirements traceability should continue from owner need through design response, submittal, installation, test and authority disposition; one requirement can have several verification methods; a door may require product evidence, frame and wall details, concealed-work inspection, operating-force review, field measurement and maintenance provisions. Conversely, one test result may support several requirements but should not be duplicated as independent evidence; the traceability matrix should expose missing links and conflicting revisions before acceptance.

Requirements traceability should include negative requirements and prohibited assumptions. A room may be authorised for a defined meeting function but not for unattended open storage, continuous remote conferencing, unusually high electronic playback, temporary public access, or operation with masking or environmental systems disabled. Those exclusions should be linked to user training, signage where authorised, operating procedures, alarm responses, and change review. Otherwise, a design that satisfied the stated source and listener model can be used under a materially different state without anyone recognising that the assurance case has been exceeded. The traceability matrix should also show dependencies between requirements. A masking criterion may depend on minimum background-state control, power, network configuration, emitter health and listener-zone access. A door criterion may depend on frame alignment, closer force, access hardware and maintenance. Dependency mapping permits a failure or change in one system to trigger review of every linked requirement rather than leaving each discipline to discover the relationship separately.[52]

Worked example 28.13. End-to-end traceability

A room has 48 consequential requirements. Forty-one are linked through design, installation and verification. Four are linked only through design, and three have no current evidence path. Calculate end-to-end traceability.

T_e is end-to-end traceability, N_e is requirements linked through verification, and N_t is total consequential requirements.

End-to-end traceability is 85.4 per cent. The seven incomplete requirements require closure or an authorised disposition.

52 MB-0856. International Organization for Standardization, ISO 12999-1:2020, JCGM 100:2008.

28.23 Technical due diligence and host-building constraints

Leased and existing diplomatic facilities require technical due diligence before a protected room is promised; the survey should trace structure, façades, roofs, ceilings, raised floors, shafts, ducts, drains, utilities, landlord systems, fire protection, access and neighbouring tenancy. Drawings may be incomplete or differ from the building; non-invasive observations should be followed by authorised openings, measurements or tests where uncertainty affects feasibility; unknown construction is a risk item, not a convenient assumption.

Host-building constraints can govern both performance and evidence; limited floor loading may prevent a heavy enclosure; low clear height can compress silencer geometry; shared chilled water, smoke control or life-safety systems can restrict isolation. Landlord access and maintenance can create recurring exposure. The due-diligence report should classify each constraint as resolved, design-controlling, requiring permission, requiring destructive verification, or outside project control. Cost and schedule reserves should reflect the remaining uncertainty.

Due diligence should include measurement strategy, not merely visual survey. Airborne isolation screening, background spectra, vibration observations, pressure relationships and operating-state logging can reveal hidden constraints before design. Test uncertainty may be large in occupied or furnished premises, but even bounded screening can distinguish a viable host from one dominated by shared services or uncontrolled adjacency. The survey should preserve raw data and exact states so that later changes can be compared. Destructive verification requires deliberate selection. Opening every uncertain assembly may be impractical or unacceptable, while one convenient opening can produce false confidence. Sampling should be based on construction eras, visible changes, structural bays, service zones and consequence. The report should state what proportion of the boundary was directly observed, what was inferred, the confidence basis and the conditions that would invalidate the inference.[53]

Worked example 28.14. Weighted due-diligence exposure

Five host-building uncertainties have consequence weights 5, 4, 4, 3 and 2. Their unresolved fractions are 1.0, 0.5, 0.25, 0.5 and 0. Calculate the weighted unresolved exposure relative to the maximum.

E_u is weighted unresolved exposure, w_i is consequence weight, and u_i is unresolved fraction.

The exposure is 52.8 per cent. The project-defined screen shows that proceeding on drawings alone would carry substantial host-building uncertainty.

Table 28-5. Host-building due-diligence register.

System or condition	Evidence sought	Consequence if unknown	Resolution route
Structure and floor	Drawings, survey, openings and load review	Unexpected continuity, vibration or inadequate capacity	Structural analysis and authorised verification
Ceiling, plenum and raised floor	Access survey, service tracing and tenancy map	Hidden cross-talk and uncontrolled access	Targeted opening and path testing
HVAC and life safety	Sequences, shafts, dampers, pressure and maintenance	Connected speech path or incompatible remedy	Integrated mechanical and fire review
Façade, roof and site	Construction, nearby access, terrain and background	External receiving opportunity and weather dependence	Survey, measurement and site control
Landlord and utilities	Rights, notice, access, shutdown and repair procedures	Uncontrolled alteration or prolonged outage	Lease, procedure and compensating controls

53 MB-1040. National Institute of Building Sciences, Whole Building Design Guide commissioning resources.

28.24 Site selection, collocation, standoff, and off-site acoustic consequence

Site selection and compound planning affect the acoustic-security environment long before a room is designed. Distance from public roads, neighbouring buildings, shared boundaries, roofs and elevated terrain changes external receiver opportunities. Collocation can bring personnel and functions inside a managed perimeter, yet it can also create dense internal adjacencies and shared infrastructure. The acoustical study should therefore examine both off-site and on-compound receiving zones rather than assuming that perimeter security resolves speech transmission.

Distance calculations are screening tools only. Outdoor propagation depends on source directivity, façade transmission, reflections, terrain, meteorology and background. A doubling of distance can reduce free-field level, but a quiet elevated receiver or reflecting courtyard can alter consequence. Site decisions should preserve design margin and avoid locating high-consequence rooms against public façades or uncontrolled rooflines without a reasoned analysis. Controlled governmental setback criteria remain with the competent authority.

Site and adjacency analysis should be maintained as the diplomatic property evolves. Nearby construction can add elevated work platforms, cranes, temporary offices, mechanical plant, public vantage points, utility diversions and new structural connections. Internal tenant moves can create quiet offices, storage access or maintenance occupancy on the receiving side of a previously controlled boundary. The master plan should therefore record foreseeable development rights, lease conditions, construction routes and future service corridors, then establish review triggers before those assumptions change. A location decision made during concept design should not become an unexamined permanent truth. Periodic property review can compare current access and source conditions with the original adjacency model, identify new listeners or excitation, and determine whether operational controls, targeted measurement, relocation or physical work is required. The public method remains generic; actual diplomatic site geometry and threat interpretation belong in the authorised project record.[54]

Worked example 28.15. Free-field distance screening

A façade-related receiving point moves from 12 metres to 30 metres from an equivalent compact source. Estimate the free-field geometric reduction, ignoring atmosphere, reflections and façade directivity.

Delta L is geometric level reduction, and r_1 and r_2 are source-receiver distances.

The screening reduction is about 8.0 dB. It is not a security criterion and does not predict the complete façade-to-listener path.

28.25 Host-country law, permits, codes, and sovereign interfaces

Diplomatic construction operates within a sovereign and legal setting that can affect permitting, labour, fire protection, accessibility, environmental controls, utilities and inspections. Privileges and immunities do not remove the need for disciplined interface management. Project counsel and authorised officials determine legal positions. Engineers should identify where local requirements, Department standards, contract requirements

54 MB-0039. American Society of Heating, Refrigerating and Air-Conditioning Engineers and recognised mechanical-system guidance, used for commissioning and operational-mode coordination.

and controlled security criteria touch the same detail, then record which authority controls each decision.

Conflicts should be resolved through design, variance, authorised exception or a documented alternative, not by silently omitting one requirement. A penetration seal may need fire, smoke, movement, acoustic and security evidence. A door may need egress, accessibility, forced-entry, acoustic, electromagnetic and operational review. The coordination record should preserve the competing requirements, selected solution, evidence, approving roles and lifecycle restrictions. Sensitive rationale can be held in a controlled annex while the construction drawing carries the buildable detail.[55]

Worked example 28.16. Multi-authority conflict closure

A coordination register contains 16 multi-authority conflicts. Thirteen have approved integrated solutions, two have interim directions and one is unresolved. Calculate final closure and directed coverage.

C_f is final closure and C_d is coverage including interim directions.

Only 81.25 per cent is finally closed. The 93.75 per cent directed value is useful for work planning but must not be reported as final resolution.

28.26 Climate, altitude, humidity, dust, corrosion, and material stability

Overseas facilities encounter heat, cold, altitude, humidity, salt, dust, insects, seismic motion, flooding and unstable utilities. These conditions can alter seals, adhesives, doors, finishes, fan capacity, pressure relationships, electronics and maintenance frequency. Acoustic performance measured

55 MB-0005. Accredited laboratory status supports competence for specified methods.

during a mild commissioning period may not represent the seasonal extreme. The environmental basis should identify the material properties and operating states that influence the protected boundary.

Climate adaptation must remain compatible with life safety and technical security. Larger ventilation rates, corrosion-resistant substitutions, insect screens, storm protection or seismic restraints can change acoustic and structural paths. Materials should be selected by tested or defensible performance under expected exposure, not by nominal similarity. Inspection intervals should be shorter where movement, contamination or corrosion can degrade joints. Seasonal or event-driven recommissioning should be specified where the consequence warrants it.[56]

Worked example 28.17. Thermal movement screening

A 6.0 metre aluminium frame experiences a 35 degree Celsius temperature change. Use a coefficient of thermal expansion of 23 x 10^-6 per degree Celsius.

Delta l is free thermal movement, alpha is thermal expansion coefficient, l is length and Delta T is temperature change.

The screened movement is 4.83 mm. Restraint, differential materials and joint geometry can change actual movement and stress. The value informs seal and interface review.

28.27 Logistics, customs, storage, chain of custody, and secure procurement

Diplomatic construction often depends on long supply chains, international transit, customs, bonded storage, local fabrication and constrained staging.

56 MB-1242. U.S. Department of Defense, ISO 10005:2018, ISO 10006:2017.

Technical-security components, door hardware, seals, panels, filters and test instruments can be damaged, substituted or separated from their records. Procurement should define approved manufacturers, configuration identifiers, packaging, inspection, storage environment, serialisation, tamper evidence, receipt verification and disposition of rejected material.

Chain of custody is not merely a security label; it is an evidence system connecting the approved submittal to the item installed in a concealed boundary; records should identify custody events, condition, seals, photographs, quantities, serial numbers and authorised releases. Where local sourcing is permitted, the equivalence review must address complete function and configuration; a material that resembles the specified item may differ in density, stiffness, permeability, ageing, fire behaviour or electromagnetic properties.

Configuration control should continue through partial shipments and field fabrication. A large module or doorset may arrive in several consignments, with hardware, seals, filters and controls following different routes. The receiving register should preserve parent-child relationships so that an assembly cannot be declared complete merely because its principal panels arrived. Field-cut pieces, locally sourced fasteners and repair materials require the same authorised equivalence process as major substitutions. Storage is another operating state. Panels can warp, seals can take a compression set, electronics can absorb moisture and adhesives can exceed shelf life. The storage plan should specify orientation, support, temperature, humidity, contamination control, inspection and expiry. Before installation, condition evidence should be compared with the dispatch baseline. A custody chain that proves identity but ignores degradation is incomplete.[57]

Worked example 28.18. Chain-of-custody completeness

A shipment contains 80 controlled interface components. Seventy-four have complete origin, transit, receipt and installation records. Four lack an installation link and two have unresolved seal discrepancies.

C_c is chain-of-custody completeness, $N_{complete}$ is fully linked components, and N_{total} is shipment count.

Completeness is 92.5 per cent. The six exceptions require resolution before concealment. Statistical acceptance is inappropriate where each item controls a consequential joint.

Table 28-6. Secure logistics and material-identity controls.

Stage	Required evidence	Typical failure	Disposition
Approved submittal	Manufacturer, model, configuration and qualification	Ambiguous or incomplete identity	Clarify before purchase
Packing and dispatch	Serials, quantities, condition and seals	Wrong part or poor protection	Hold and reconcile
Transit and customs	Custody events, openings and environmental exposure	Damage, substitution or lost linkage	Inspect and investigate
Receipt and storage	Seal check, photographs, controlled location and climate	Unrecorded opening or degradation	Quarantine or authorised release
Installation	Item-to-location linkage and hold-point record	Correct product installed at wrong interface	Correct before concealment

57 MB-0933. ISO 19011:2026.

28.28 Construction Security Plans and project certification

Qualifying construction and renovation work requires security planning and certification before the work proceeds under the applicable Department framework. The acoustic programme should be embedded in that project structure rather than run as a disconnected consultant exercise. The Construction Security Plan should identify protected areas, work zones, personnel controls, materials, surveillance, information handling, devices, inspections, incident response and the authority for changes. Acoustic hold points can then be aligned with the security sequence.

Certification is a governance action supported by evidence, not a retrospective label applied after construction; late discovery that a project penetrated a controlled boundary can invalidate the planned surveillance and leave concealed conditions unverifiable; scope screening should occur at project inception and again when design changes. The schedule should include time for controlled review, authorised corrections and repeat inspection; construction urgency does not cure a missing prerequisite.

Scope control must include enabling and temporary work. A contractor may open a controlled boundary to route temporary power, install monitoring, dry a water-damaged cavity or gain access for another trade. Such work can create the same exposure as the permanent project and may occur before the formal construction package is thought to begin. The security plan should define when the protected condition starts, which temporary penetrations or enclosures are permitted, how they are inspected and how restoration is verified. Design changes should be screened against the certification basis. A seemingly minor relocation can move work into a controlled access area, penetrate its outer plane or alter material provenance. The project register should capture changes early enough for authorised review, rather than asking the certifying office to regularise a completed condition.[58]

Worked example 28.19. Certification schedule reserve

A project needs 45 calendar days for controlled review, 12 days for expected comment resolution and 8 days of management reserve. Construction mobilisation is planned 70 days after submission.

T_req is required review allowance, T_m is available mobilisation interval, and B_s is schedule buffer.

Only five days of buffer remain. The calculation is a project schedule screen, not a prediction of governmental review time. Work must not begin merely because the modelled duration expired.

Figure 28-4. Construction-security evidence moves through material identity, secure custody, first-of-type work, inspection, measurement, nonconformance, as-built records and controlled release; missed evidence triggers stop-work and recovery. Author original diagram.

28.29 Site Security Manager, construction-surveillance technicians, escorts, and protected workflows

Construction security depends on competent people working within defined authority. The Site Security Manager coordinates the security programme, while surveillance technicians, escorts, inspectors, contractors and government representatives perform distinct duties. Acoustic specialists may identify conditions requiring observation, but should not assume surveillance authority they do not possess. The staffing plan should map tasks, zones, shifts, languages, access, reporting and relief so that consequential work is not performed during a coverage gap.

58 MB-0948. ISO/IEC 17020:2026.

Protected workflows require more than headcount. Observers need current drawings, approved devices, escalation contacts, stop-work authority, evidence forms and a clear definition of what must remain visible. Repetitive work can induce fatigue and sampling drift. Shift turnover should include open conditions and pending hold points. When a surveillance event is missed, the record should state what evidence was lost and which recovery options remain, including authorised opening, non-destructive examination or conservative replacement.[59]

Worked example 28.20. Escort staffing demand

Three work crews operate for ten hours. Each crew requires continuous escort. A fourth escort provides breaks and incident coverage for eight hours. Calculate total escort-hours and the average concurrent staffing over the ten-hour workday.

H_e is escort-hours and N_avg is average concurrent staffing.

The average is 3.8 escorts, but a staffing schedule must still prove continuous coverage at every moment. An average cannot reveal a two-hour gap.

28.30 Concealed-work hold points and evidence architecture

A hold point is the last planned moment at which a consequential condition can be observed without destructive work. Diplomatic acoustic construction has many such moments: backing and perimeter joints before closure, seals before trim, resilient supports before ceilings, firestop depth before cover plates, module joints before finish panels, and service routing before access

59 MB-1243. U.S. Department of Defense, ISO/IEC 17020:2026.

is restricted. The inspection plan should connect each requirement to a hold point, evidence type, authorised observer and release decision.

Evidence should be sufficient, proportionate and controlled; photographs need scale, orientation, stable location identifiers and metadata; measurements require instrument identity and calibration; material records require lot or serial linkage. A checklist without supporting observation can prove only that a box was marked. Conversely, indiscriminate imagery can create unnecessary security exposure. Tiered records, controlled repositories and abstracted public summaries allow useful evidence without universal distribution.

Hold-point evidence should support later causal analysis. A close photograph of sealant may show continuity but not location. A wide photograph may show location but not depth or backing. The evidence plan should therefore combine context, detail and measurement. Where imagery is restricted, an authorised observer can complete a controlled dimensional record and release a less detailed verification statement to the ordinary project file. Digital signatures and hashes can preserve identity, but they cannot prove that the observer understood the requirement. Competency and calibration remain necessary. Sampling is appropriate only where the acceptance plan justifies it. Repeated penetrations made by the same crew under stable conditions may permit statistical observation, while one unique high-consequence interface generally requires complete inspection. The sampling rule, lot definition, randomisation, escalation and treatment of discovered defects should be established before work begins.[60]

60 MB-1237. U.S. Department of Defense, UFC 4-010-05.

Worked example 28.21. Hold-point release coverage

Twenty-two concealed-work hold points are scheduled. Nineteen were observed and released with complete evidence. Two were observed but lack material identity, and one was missed.

C_h is complete hold-point coverage, N_complete is fully evidenced releases, and N_total is scheduled hold points.

Complete coverage is 86.4 per cent. The three exceptions require authorised recovery. They cannot be converted to passes by administrative closeout.

Table 28-7. Concealed-work hold-point and evidence matrix.

Condition	Last observable stage	Minimum evidence	Recovery if missed
Wall or module perimeter	Before trim or finish closure	Dimensions, backing, seal depth and continuous observation	Authorised opening or conservative replacement
Resilient support	Before board or ceiling concealment	Support identity, spacing, fasteners and isolation clearance	Targeted opening and vibration diagnosis
Door frame and threshold	Before perimeter cover and final flooring	Anchors, plumb, twist, grout or backing and seals	Remove trim, survey and correct
Service penetration	Before cover plate or inaccessible closeout	Sleeve, annulus, material identity and depth	Open, inspect and reinstate
HVAC silencer or transition	Before shaft or ceiling closure	Orientation, joints, supports, access and fire interfaces	Borescope, access opening or rework

28.31 Security-minded information management and tiered record release

Diplomatic project information can reveal room location, construction, service routes, access, vulnerabilities and operating assumptions. Security-minded information management begins by identifying the information consequence, not by labelling every file identically. The project should define tiers for public, ordinary project, controlled project and restricted technical records, together with authorised repositories, devices, transfers, retention and destruction. Stable identifiers allow a public drawing register to prove that a controlled detail exists without reproducing the detail itself.

Access should follow role and need. Designers may require complete interfaces, while installers need buildable work packages and inspectors need evidence criteria; operations staff require maintainable baseline information, and public publications require abstraction; redaction must preserve meaning and version control; a redacted record that removes the very dimension or state supporting an acceptance claim is not usable evidence. The master register should link every derivative to its controlling source and record who approved the release.

Information release should be treated as a designed product. A public technical narrative can explain governance, physics, uncertainty and generic examples. A contractor package can show the details required for fabrication. An inspection package can add acceptance characteristics. A controlled authority package can contain protected criteria and facility-specific implications. Each derivative should have a named purpose, audience, source baseline and release authority. Automated redaction requires human review because metadata, layers, revision histories, embedded objects and file names can disclose more than the visible page. Exporting a model to PDF does not necessarily remove hidden content. Package verification should inspect both appearance and structure, and superseded derivatives should be withdrawn or clearly marked so that field personnel do not build from an obsolete, less restricted copy.[61]

61 MB-0009. Acoustic Security Engineering for Secure Rooms, Revision 1.2C2, Chapters 28 through 32 public-source registers and jurisdictional crosswalks. Similar terms can carry different legal and institutional meanings. Controlled criteria are neithe.

Worked example 28.22. Least-access screening

A controlled record is available to 42 accounts. Review finds that 31 accounts require full access, six require only a redacted derivative, and five no longer require access. Calculate the avoidable full-access proportion.

N_a is avoidable full access and P_a is its proportion of current accounts.

Approximately 26.2 per cent of full access is avoidable. The screening result supports access review but does not determine personnel eligibility or classification.

28.32 Communications, audiovisual, secure voice, and conferencing integration

Diplomatic conference rooms combine speech protection with telephones, secure voice, video, interpretation, displays, cameras, microphones, loudspeakers, control networks and support access. Each device can alter source level, acoustic path, electrical penetration, electromagnetic configuration, cyber exposure and maintenance demand. Integration must begin with an approved equipment and state register. Muted, idle, standby, diagnostic, emergency and software-update states can differ materially from the normal meeting configuration.

Interfaces should be designed so that cables, mounts, ventilation, access panels and service replacement do not defeat the room boundary. Commissioning must exercise the complete signal chain, including maximum authorised output, echo control, failover, network loss, remote administration and loss of power. Acoustic acceptance does not certify the communications security or software. Conversely, a communications approval does not prove that loudspeaker energy, fan noise or new penetrations remain within the acoustic baseline.

The audiovisual acceptance matrix should identify every path by source, destination, transport, codec or signal type, operating authority and physical boundary crossing. A conference bar can combine microphone, loudspeaker, camera, wireless radio, USB, network, power and remote-management functions in one enclosure. Treating it as one asset conceals several paths. The record should preserve approved firmware, settings, certificates, network addresses, administrator roles, microphone and loudspeaker limits, cable routes and physical mounts. Diagnostic access deserves separate control because a technician may enable test audio, remote viewing or logging that is absent during normal use. The maintenance state should be tested and should carry explicit restrictions. Replacement by a newer model requires equivalence across acoustics, interfaces, software, supply chain and authority, not merely compatibility with the display.[62]

Worked example 28.23. End-to-end latency budget

A conferencing path has 12 milliseconds of capture processing, 18 milliseconds of encoding, 34 milliseconds of network transport, 20 milliseconds of decoding and 16 milliseconds of playback buffering.

T_total is one-way latency and T_i are component delays.

One-way latency is 100 milliseconds. This can affect conversational behaviour and vocal effort, but it does not by itself establish intelligibility, security or acceptable quality.

62 MB-1242. U.S. Department of Defense, ISO 10005:2018, ISO 10006:2017.

28.33 HVAC, power, fire and life safety, and security-system coordination

A protected diplomatic room remains part of a building. It requires ventilation, power, fire detection, suppression, emergency communication, egress, accessibility and often pressure control. These systems create openings, connected paths, structural supports and maintenance access. The design should trace each service from source room to its next accessible or shared space and identify the acoustic, fire, smoke, structural, electrical and security controls at every crossing.

Operating states matter. Fans cycle, dampers close, generators start, smoke-control sequences override normal operation and maintenance opens access panels; a silencer selected only for normal airflow may regenerate noise or impose unacceptable pressure loss at emergency conditions; a fire damper or detector cannot be obstructed by an acoustic remedy. Integrated testing should verify both ordinary performance and the applicable life-safety sequence, while preserving the distinction between safe evacuation and authorised protected use; a room may need to suspend protected discussion during an emergency state.

Service coordination should include the receiving side of every system. A supply duct may terminate in the protected room but connect through a branch, shaft or air-handling unit to several accessible spaces. Electrical conduit can open into panels or ceiling zones. Sprinkler and drain piping can carry vibration into remote structure. The model should show supports, transitions, access doors, dampers, silencers, flexible connections and maintenance clearances along the complete path. Commissioning should challenge credible combinations such as low airflow with quiet background, full airflow with regenerated noise, standby power, smoke-control override and a single fan or damper failure. Results should identify which states support protected use and which require suspension. Life-safety operation remains paramount, but its acoustic consequence should be known before an emergency rather than discovered during one.[63]

Worked example 28.24. Ventilation opening screen

A room requires 0.42 cubic metres per second of supply air. A grille is limited to a design face velocity of 2.1 metres per second. Estimate the net free area before grille and silencer corrections.

A_f is net free area, Q is volume flow and v is face velocity.

The screened free area is 0.20 square metres. Actual selection must include grille free-area ratio, pressure loss, regenerated noise, fire and smoke requirements, and acoustic insertion loss.

28.34 Modular enclosure and host-room integration

A modular treated enclosure is not independent of its host room; the host structure carries weight and may transmit vibration; the surrounding air volume affects heat rejection, access and fire protection; floor levelness controls panel joints and door geometry. Ceiling height constrains ventilation and service transitions. Egress, accessibility, lighting, sprinklers, detectors and maintenance clearances remain building obligations. The interface schedule should assign every host-to-module connection to a responsible discipline and identify whether it is part of the tested or approved configuration.

63 MB-0946. ISO 9001:2015, ISO 10005:2018.

The module should arrive with configuration identity, panel and joint schedules, door and seal data, service-interface details, installation tolerances, inspection requirements, spares and field-test provisions. Field modifications require controlled approval. A locally drilled hole, substituted fastener or improvised duct connection can alter several protection domains. The host-room as-built survey should be completed before manufacture is frozen, and the installed geometry should be reconciled before acceptance testing.

Host-room tolerances should be specified as part of modular integration. Slab flatness, level, deflection, joint movement, ceiling clearance, wall plumb, access width, lifting route, electrical capacity, ventilation duty, drainage and fire-protection geometry can determine whether the enclosure is assembled as approved. Field correction by shimming, cutting, drilling or adding rigid brackets may create paths or invalidate evidence. The installation plan should state permitted adjustment methods, maximum tolerances, inspection points and the authority required for deviation. It should also address removal and replacement. A module that can only be serviced by dismantling a controlled wall or disabling critical life-safety systems creates a lifecycle weakness. The as-installed model should map every panel, joint, service connection and host interface, while the maintenance plan defines inspection, approved spare components, software or controller state, seal replacement and field-test triggers. Factory identity, site identity and maintained identity must remain connected throughout the lifecycle.[64]

64 MB-0946. ISO 9001:2015, ISO 10005:2018.

Worked example 28.25. Module floor-load screen

A modular enclosure weighs 18,600 kilograms and bears on a 72 square metre footprint. Calculate the average imposed pressure, excluding occupants and equipment.

p is average pressure, m is mass, g is gravitational acceleration and A is footprint area.

Average pressure is 2.53 kilopascals, about 52.9 pounds per square foot. Local supports and load paths can be much higher and require structural review.

28.35 Factory acceptance, shipping, reassembly, and site equivalence

Factory acceptance can verify manufacture, component identity, fit, selected performance and documentation before an enclosure enters a difficult overseas supply chain. It cannot prove the final host structure, service routing, field joints, local repairs or operating environment. The factory test plan should identify the exact configuration, temporary fixtures, measurement limitations, deviations and items left for site verification. Components should be marked so that reassembly and replacement remain traceable.

Transit introduces shock, vibration, moisture, temperature, customs opening and repackaging. Receipt inspection should compare seals, packaging, serials, dimensions and condition with the dispatch record. Site equivalence requires more than visual completeness. It should reconcile configuration, joint compression, door geometry, services, supports, environment and commissioning results. Factory and field evidence should be reported as complementary stages, not averaged into one performance number.[65]

Worked example 28.26. Shipping shock force screen

A 240 kilogram panel assembly experiences a measured peak acceleration of 4.5 g during transit. Estimate the corresponding inertial force.

F is inertial force, m is mass and a is peak acceleration.

The screened inertial force is 10.6 kilonewtons. Actual panel stress depends on pulse duration, support, packaging, orientation and dynamic response. The event should trigger condition review, not automatic rejection or acceptance.

28.36 Commissioning plan and functional performance testing

Commissioning should be planned while requirements can still influence design and contract language. The plan identifies systems, prerequisites, participants, instruments, source states, functional sequences, acceptance methods, documentation and issue closure. For a diplomatic room, commissioning extends beyond an acoustic test. Doors, seals, HVAC, masking, power, communications, controls, alarms, emergency modes, access and maintenance interfaces must be exercised as a configured system.

Functional performance testing should challenge credible failures and transitions; a door should be cycled, a fan mode changed, a masking zone disabled, a conference preset loaded, power interrupted and restored, and an alarm or emergency override exercised where authorised. Adjustments

65 MB-0936. ISO 19650-1:2018, ISO 19650-2:2018.

made during testing become controlled changes; the final record should identify the exact as-left state and distinguish verified correction from deferred work; substantial completion should not be declared merely because the room can be occupied.

Commissioning independence should be proportionate to consequence. The installer can perform prefunctional checks and adjustment, but final verification benefits from a reviewer who is not rewarded merely for achieving a pass. Witness roles, authority and data custody should be established before testing. Where a test fails, the team should preserve the original data and configuration, diagnose the mechanism, approve the correction and repeat the affected sequence. Deleting the failed run or averaging it with a later pass destroys valuable evidence. Seasonal and occupancy effects should be addressed through the commissioning basis. A newly completed room may be tested before full furniture, staff, network traffic or local climate extremes exist. The acceptance record should state which states were simulated, which require deferred testing and what interim restrictions apply. Deferred commissioning is a controlled obligation, not an informal promise.[66]

Worked example 28.27. Weighted commissioning completion

A commissioning plan contains 60 tests. Forty high-consequence tests carry weight 2 and twenty ordinary tests carry weight 1. Thirty-eight high-consequence and eighteen ordinary tests have passed with complete records.

66 MB-1177. The equations and numerical examples in this chapter are screening tools developed for teaching and project planning. They do not create universal sampling rates, acceptance thresholds, probabilities or evidentiary presumptions.

C_c is weighted commissioning completion. N_{hp} and N_{op} are passed tests, while N_h and N_o are planned high-consequence and ordinary tests.

Weighted completion is 94 per cent. The two incomplete high-consequence tests remain release blockers unless the competent authority issues a bounded disposition.

Table 28-8. Diplomatic-room commissioning and functional-test matrix.

Test state	Systems exercised	Primary evidence	Release implication
Normal protected use	Doors, HVAC, masking and conferencing	Configured acoustic and operational result	Baseline candidate
Maximum authorised source	Voice or electronic output and room controls	Band levels, local paths and limiting state	Challenge-state evidence
Single failure	Masking zone, fan, power or communications loss	Alarm, transition and degraded result	Restriction or compensating control
Emergency or life safety	Fire, evacuation and override sequence	Safe operation and protected-use boundary	May require stop-use condition
Restoration	Restart, configuration and log recovery	As-left identity and repeat checks	Return-to-service evidence

28.37 Acoustic field testing, source states, uncertainty, and decision rules

Field testing should begin with the measurand and decision question. Room-to-room level difference, apparent sound reduction, local intensity, vibration response, background, masking and speech-related quantities answer different questions. The test plan should state frequency range, spatial sampling, temporal sampling, source, rooms, doors, HVAC, equipment, listener locations, calibration, background correction and raw-data retention. The selected source state should represent the authorised use or a justified challenge condition.

Uncertainty belongs in the decision, not merely in an appendix; calibration, repeatability, source position, microphone position, background, decay, environmental state and processing can contribute; correlation may cancel or compound components; the acceptance rule should state whether uncertainty is applied as a guard band, how borderline results are treated, and who bears decision risk. A favourable single-number class should not conceal a failing band, local path or untested state.

The measurement report should preserve frequency-resolved results and the reasons for every correction. Background correction becomes unstable when receiving levels approach background. Spatial averages can hide a local dominant path. Reverberation normalisation can be inappropriate where the receiving field is strongly non-diffuse or where the method's room-volume assumptions are not met. The investigator should identify those limitations rather than forcing every dataset through one formula. Reproducibility requires enough detail for another competent team to reconstruct the state: source equipment and spectrum, coordinates, room conditions, microphone chain, calibration, environmental data, averaging, rejected observations, software, processing and uncertainty model. Raw files should remain immutable, with derived files linked through hashes and processing records. The decision conclusion should quote the actual rule and remain separate from engineering recommendations for additional margin.[67]

67 MB-0948. ISO/IEC 17020:2026.

Worked example 28.28. Expanded uncertainty and guard band

Independent standard uncertainty components are 0.4, 0.7, 0.6 and 0.5 dB. Use coverage factor k equals 2. A measured result is 2.5 dB above a minimum requirement.

u_c is combined standard uncertainty and U is expanded uncertainty.

The 2.5 dB margin exceeds the 2.24 dB guard band by only 0.26 dB. The project decision rule may classify the result as a narrow pass, require confirmation, or impose additional margin.

28.38 Authority language, certification, accreditation, and use authorisation

Technical reports must use institutional verbs carefully. Measured, observed, calculated, verified, commissioned, certified, accredited, approved and authorised do not mean the same thing. An acoustical engineer can state that a method-defined result was measured and that the configured work conformed to a project requirement within stated uncertainty. The engineer should not state that a Department facility is accredited or authorised unless empowered to make that decision and unless the complete applicable process has been satisfied.

The release record should identify the technical conclusion, the governmental disposition, any conditions, the authorised use, effective date, review triggers and controlling documents; conditional approval should be visible to users and maintainers; a certificate without configuration identity, limitations or authority can be dangerously broad. Conversely, a competent-authority decision does not change the laws of physics; if evidence is incomplete, the record should show the gap and the risk accepted, rather than rewriting uncertainty as certainty.

Authority language should remain consistent across contract, commissioning and operational documents; the contractor's certificate of conformance addresses the supplied work within the contract; a commissioning report records functional and performance evidence under the test plan; a security certification or facility accreditation belongs to the governmental process. A post instruction governs actual use. These records should cross-reference one another but should not repeat broader verbs than the issuer is empowered to use. Reviewers should search for ambiguous terms such as secure, certified, approved, accredited, compliant and final, then identify the object, criterion, issuer and scope for each occurrence. Where a report states that a room passed, it should name the quantity, limit, configuration, uncertainty and decision rule. Where an authority permits use, it should name the authorised activity, restrictions, expiry and reopening triggers. This linguistic discipline reduces both legal ambiguity and technical overclaiming.

Authority language should remain stable in derivative documents. A commissioning report may state that a measured quantity met the project criterion under a specified decision rule. A construction-security memorandum may certify the project under the applicable programme. An accrediting authority may approve a facility for a stated function. A public summary should not collapse these into the claim that the room is government certified or universally secure. The release register should list each operative disposition, issuing office, date, scope, configuration, conditions, exclusions and supersession status. Where one decision depends on another, the dependency should be explicit. For example, use authorisation may be conditioned on completion of a maintenance action, continued monitoring, restricted equipment, or a future test. If the condition expires or the configuration changes, the downstream authority status should be reviewed rather than assumed to persist. Precision in language preserves both technical meaning and institutional legitimacy.[68]

Worked example 28.29. Decision-record completeness

A use decision requires eight fields: room identity, authorised use, configuration, supporting tests, limitations, authority, date and review triggers. Seven are complete and one review-trigger field is absent.

C_u is decision-record completeness.

Completeness is 87.5 per cent. The missing trigger is consequential because future changes could be made without mandatory review. The score does not evaluate the authority or technical correctness of the decision.

28.39 Nonconformance, waiver, exception, mitigation, and residual risk

Project records should separate a construction nonconformance from a statutory waiver, a standards exception, a design deviation, a test failure and an operational restriction; a contractor cannot cure a failed installation by calling it an exception; an engineer cannot issue a statutory waiver. Each category has a defined origin, decision authority, evidence burden and closure route; misclassification weakens oversight and can allow temporary measures to become permanent without review.

68 MB-0073. ASTM E2174-24, ASTM E2393-24.

Mitigation should address mechanism and consequence. Added masking may reduce intelligibility but leave a construction defect and create a power-dependent condition; restricted adjoining access may reduce immediate exposure but require continuous operational control; a physical repair may introduce fire or maintenance issues; residual risk should be stated after mitigation, together with assumptions, monitoring, expiry and retest. The authority then decides whether the bounded condition is acceptable for the stated use.

A disposition should be written so that a future maintainer can tell exactly what was accepted. It should identify the deficient requirement, observed condition, affected location, analysis, mitigation, authority, authorised use, effective period, inspections, monitoring and closure trigger. Language such as approved as noted is inadequate when the noted condition sits in an inaccessible meeting attachment or a superseded email. Temporary dispositions should expire automatically unless affirmatively renewed. Repeated renewal can indicate that a temporary control has become an unmanaged design choice. Portfolio review should identify recurring exceptions and convert them into improved standards, details, procurement controls or training, while preserving facility-specific information in the controlled record.[69]

Worked example 28.30. Residual-risk screen

A project-defined initial likelihood score is 0.30 and consequence is 8 on a ten-point scale. Verified mitigation is estimated to reduce likelihood by 65 per cent while consequence remains unchanged.

69 MB-0950. ISO/IEC 17025:2017.

R_0 and R_r are project screening values, P is likelihood, C is consequence and M is mitigation effectiveness.

The screen falls from 2.40 to 0.84. The numbers are not governmental risk criteria. The mitigation estimate requires evidence and continuing control.

Table 28-9. Disposition terminology and authority boundaries.

Record type	Origin	Decision authority	Required closure evidence
Construction nonconformance	Installed work differs from approved requirement	Contract and designated project authority	Correction or accepted bounded disposition
Design deviation	Proposed departure before installation	Design and applicable security authorities	Approved analysis and revised baseline
Standards exception	Departure from applicable policy standard	Authority defined by governing policy	Mitigation, approval, tracking and review
Statutory waiver	Departure permitted under statute	Statutorily authorised official	Formal waiver and required mitigation
Operational restriction	Use bounded to control residual risk	Competent use authority	Published restriction, monitoring and expiry

28.40 Substantial completion, punch lists, turnover, and final acceptance

Substantial completion indicates that a facility can be used for its intended purpose under the contract, but protected-room acceptance requires careful separation of ordinary completion from security disposition. Outstanding door adjustment, controls, documentation, training or as-built records can materially affect the room even when general occupancy is possible. The punch list should classify items by consequence and prevent cosmetic closure from obscuring protection-critical work.

Turnover should include approved as-built drawings, equipment and serial registers, configuration exports, test records, calibration, warranties, spare parts, maintenance procedures, training, unresolved issues and authority decisions. Documents should be searchable and linked to the actual installed state. Final acceptance should confirm that corrections were retested where mechanism required it. A promise to finish after occupancy is not equivalent to a verified baseline.

Closeout should include a reconciliation walk that compares the accepted drawings, asset register, room data sheet, penetration schedule, door and seal schedule, software baseline, commissioning records and physical installation. Discrepancies should be resolved before project staff and contractor knowledge disperse. The walk should verify labels and access provisions without creating uncontrolled markings or records that expose protected details. Training and spare-parts delivery should be tested as functional obligations rather than acknowledged by receipt alone. The receiving team should demonstrate that it can identify the controlled state, recognise a stop-use condition, open a compliant work request, retrieve the correct baseline, perform permitted checks and escalate a suspected change. Final acceptance should state which records and duties transfer to operations, which contractor obligations survive, which deferred tests remain, and which authority conditions continue. Administrative completion without operational competence merely transfers an undocumented defect into the facility lifecycle.[70]

Worked example 28.31. Punch-list burn-down

A protected-room punch list begins with 36 items. Twenty-eight are verified closed, five are contractor-complete but awaiting verification, and three remain open.

70 MB-0936. ISO 19650-1:2018, ISO 19650-2:2018.

B_v is verified burn-down and B_w includes work reported complete but awaiting verification.

Verified burn-down is 77.8 per cent, not 91.7 per cent. Release reporting should use the verified value and list the eight outstanding evidence or work items.

28.41 Operations baseline, maintenance system, spares, and training

The room enters service as a configured asset, not as a completed drawing. The operations baseline should identify boundary elements, doors, seals, HVAC, power, masking, communications, controls, software, authorised states, test data, spares and restrictions. Maintenance tasks should be attached to mechanisms. Cleaning a seal, adjusting a closer, replacing a fan filter, checking a controller or inspecting a cable sleeve has meaning only when the required condition and evidence are defined.

Spares and training determine whether the baseline survives. An unavailable proprietary gasket can invite an unapproved substitution. Staff turnover can erase the reason a door must not be wedged or a firmware update must be reviewed. Training should cover normal operation, alarms, stop-use conditions, reporting, approved maintenance, evidence capture and escalation. The asset system should preserve part identity, work history and recommissioning triggers so that local repair remains visible to security and engineering authorities.[71]

71 MB-1242. U.S. Department of Defense, ISO 10005:2018, ISO 10006:2017.

Worked example 28.32. Critical-spares availability

A room has 14 critical spare-part classes. Eleven are on site, two have approved regional availability within the required restoration interval, and one has no approved source.

A_s is approved spares availability.

Availability is 92.9 per cent. The missing class can still dominate restoration risk and should be resolved or supported by an authorised contingency.

28.42 Facility Operations, SRM, minor construction, and event-driven recommissioning

Facility Operations and Sustainment, Restoration and Modernization programmes continually alter diplomatic buildings. Painting, ceiling work, cabling, access-control upgrades, fire-alarm replacement, HVAC balancing, water leaks and minor construction can affect a protected room without being described as a security project. Work-order and project systems should flag the room and its adjoining paths so that proposed work is screened before authorisation.

Recommissioning should be event driven as well as periodic; triggers can include door or seal replacement, penetration, structural work, HVAC change, masking or conferencing update, water intrusion, fire event, unexplained complaint, change in adjoining access or material mission change. The review scope should follow the mechanism; a local cable repair may require penetration inspection and targeted measurement rather than a complete programme; the decision and evidence should still be recorded against the controlled baseline.

Work-screening systems should use both location and mechanism. A work order several rooms away can still affect a protected path if it touches a shared slab, shaft, duct, roof curb, riser, control network or masking zone. Conversely, ordinary cosmetic work inside the room may have little consequence if it does not alter absorption, access or protected interfaces. The asset model should therefore associate the room with its extended path network and flag related systems. After work, closeout should compare pre-work and post-work configurations, verify temporary openings are restored, reconcile materials and settings, and determine whether targeted measurement is sufficient. Recommissioning scope should be approved before evidence disappears.[72]

Worked example 28.33. Recommissioning trigger score

A change affects a boundary penetration with consequence weight 5, modifies HVAC state with weight 4, and changes software with weight 2. Review finds impact factors 1.0, 0.5 and 0.25. Calculate the weighted trigger score.

S_t is a project-defined trigger score, w_i are consequence weights and f_i are impact factors.

A score of 7.5 indicates a multi-mechanism change requiring coordinated review. The project must predefine action bands. The value is not a Department criterion.

Table 28-10. Lifecycle change and recommissioning triggers.

Change or event	Mechanism affected	Minimum review	Possible test scope
Door, frame or seal replacement	Dominant opening path and operation	Product, geometry and maintenance review	Door and local room-pair test

72 MB-0936. ISO 19650-1:2018, ISO 19650-2:2018.

Change or event	Mechanism affected	Minimum review	Possible test scope
Cable or service penetration	Air path, structure and multi-domain interface	Approved detail and concealed-work inspection	Targeted leakage and configuration check
HVAC rebalance or equipment change	Duct path, background and pressure	Mechanical state and silencer review	Band background and path testing
Masking or conferencing update	Source, background, network and software state	Configuration and cybersecurity review	Spatial map and functional test
Incident, water, fire or structural work	Unknown degradation and evidence state	Incident investigation and boundary survey	Mechanism-led partial or full recommissioning

28.43 Incident response, evidence preservation, and causal attribution

An acoustic complaint, alarm, unexplained configuration change or suspected information exposure requires disciplined response. Immediate actions may include suspending protected use, controlling adjoining access, preserving volatile logs and recording the current state before repair. The team should establish a common time reference and collect raw acoustic data, controller histories, work orders, access records, photographs, witness observations and configuration hashes. A complaint is evidence of concern, not proof of a particular leak or compromise.

Causal analysis should proceed from non-invasive state changes to targeted measurements and authorised openings. Temporary seals, fan changes, door adjustments and source relocation can discriminate among paths, but collateral effects must be recorded. The investigator should distinguish defect, failure mechanism, exposure opportunity and actual information recovery. Return to service requires an identified as-left configuration, test evidence, limitations and authority. Urgency does not justify destroying the condition before it is documented.[73]

Worked example 28.34. Evidence-preservation completeness

An incident plan requires 18 evidence classes. Fifteen were preserved with original timestamps and hashes, two were captured without hashes, and one volatile log was lost.

C_e is complete evidence preservation.

Completeness is 83.3 per cent. The two unhashed captures may remain usable with disclosed limitations. The lost log must be recorded as an evidentiary gap, not reconstructed from memory.

28.44 Lessons learned, oversight, and portfolio-level feedback

Diplomatic construction programmes should learn across projects without distributing protected details; lessons can be abstracted by mechanism, project stage, evidence failure, organisational interface and corrective control; a door-seal defect can become a general requirement for frame geometry, hold-point inspection and maintenance without identifying a facility. A missed commissioning record can become a standard closeout control; useful lessons contain evidence, cause, applicability, owner, implementation and verification.

Oversight reports show why quality control matters. Lessons databases can contain errors, duplication or weak closure. Portfolio statistics can reward reporting volume rather than prevention. Each lesson should therefore be technically reviewed, linked to the source record, assigned to specifications,

73 MB-0006. Acoustic Security Engineering for Secure Rooms, Revision 1.2C2, Chapter 33 cumulative treatment. Chapter 34 implements the requirement identifiers.

training or process, and later tested for implementation. Conflicting lessons should remain visible until resolved. A programme that collects anecdotes without changing requirements has not completed the learning cycle.[74]

Worked example 28.35. Verified lesson implementation

A programme approves 50 lessons for action. Forty are incorporated into controlled templates or training, but only 31 have been verified on a later project.

I_a is administrative implementation and I_v is verified implementation.

Administrative implementation is 80 per cent, while verified implementation is 62 per cent. The gap shows why document updates alone do not prove field adoption.

28.45 Integrated diplomatic-room assurance and the release boundary

Integrated assurance begins with authorised diplomatic use and proceeds through site, host building, structure, envelope, services, acoustic response, electromagnetic interfaces, communications, cyber controls, life safety, construction evidence, commissioning, operations and competent authority. The system cannot be reduced to a headline STC, a vendor label, a module name or one successful field test. Each layer has its own owner, evidence and failure state, yet shared interfaces require coordinated review.

The final technical dossier should state the configuration demonstrated, the source and receiving states, measurements, uncertainty, deviations, unresolved conditions, operational restrictions and change triggers. It should identify which conclusions rest on public authority, which depend on

74 MB-0069. ASTM C919-24.

controlled criteria and which remain professional engineering interpretations. Public release should use abstracted methods and synthetic examples. Facility-specific vulnerabilities, controlled thresholds and protected operating procedures remain outside this monograph.

The strongest defensible conclusion is bounded. The room and its supporting systems demonstrated stated performance under listed conditions at the recorded date. Continued validity depends on maintenance, access, configuration and event-driven review. Acoustic acceptance does not establish immunity from electronic, optical, radio-frequency, cyber, mechanical or insider threats, and it does not itself grant governmental accreditation or use authority.

The assurance case should be navigable from consequence to evidence. A reviewer examining a quiet-hour leakage risk should be able to identify the authorised use, adjoining access, relevant path, design control, concealed-work evidence, test state, uncertainty, mitigation, operational restriction and lifecycle owner without searching several disconnected archives. This structure supports oversight, maintenance and legal review while reducing the temptation to rely on a summary certificate. Residual uncertainty should be divided into measured variability, model uncertainty, inaccessible construction, untested operating states and threats outside acoustic scope. Each category has a different treatment. Additional sampling can reduce measured uncertainty. Authorised opening may resolve inaccessible work. An operational restriction can manage an untested state. No acoustic action can close an unrelated cyber or insider pathway. The final release language should make those distinctions visible and should identify the precise event that requires the case to be reopened.[75]

Worked example 28.36. Integrated evidence coverage

Eight assurance layers have verified coverage values of 0.96, 0.92, 0.88, 0.94, 0.90, 0.95, 0.86 and 0.93. Calculate the arithmetic mean and the weakest layer.

A_mean is average evidence coverage and A_min is the weakest-layer screen.

Average coverage is 91.8 per cent, but the weakest layer is 86 per cent. Release review should examine the weak layer rather than allowing the mean to conceal it. Neither value is a security rating.

Figure 28-5. Diplomatic secure-room assurance operates as a lifecycle loop linking threat and mission review, operations, monitoring, change, incident response, repair, evidence updates, inspection, targeted recommissioning and competent-authority decision. Author original diagram.

Chapter 28 establishes a public, disciplined framework for United States diplomatic-facility acoustic security. Statute and Department policy identify authority, terminology, construction-security programmes, facility delivery and lifecycle responsibilities, while controlled technical criteria remain with authorised holders.

The engineering task is to connect authorised use, host conditions, construction evidence, multi-domain interfaces, commissioning, uncertainty, maintenance and change without converting a public source or private calculation into governmental accreditation. Every conclusion remains bounded to its configuration, state, method and authority.

75 MB-1242. U.S. Department of Defense, ISO 10005:2018, ISO 10006:2017.

Chapter 29 broadens the United States analysis to public Intelligence Community, Department of Defense and SCIF doctrine. Similar physical mechanisms will be retained, but authorities, terminology and reciprocal-use structures will not be treated as interchangeable.

Chapter 28 Glossary

Acoustic conference room. Department of State term whose meaning must be taken from the controlling public or controlled source.

Competent authority. Official or organisation empowered to decide a defined governmental use or acceptance question.

Diplomatic facility. Facility supporting diplomatic, consular or related governmental functions, often under overseas conditions.

Modular treated conference room. Department of State term for a modular protected conference-room concept under the applicable authority.

Public-source boundary. Point beyond which controlled or non-public criteria are not reproduced or inferred.

Restricted record. Project information whose collection, access, distribution or retention is controlled.

Treated conference room. Department of State term for a specialised conference environment under applicable policy and criteria.

Use authorisation. Institutional decision permitting a room to support a defined function under stated conditions.

Accreditation. Formal institutional determination by an authorised official or organisation under the applicable governmental framework.

As-left state. Exact configuration and operating condition remaining after commissioning, repair or investigation.

Authority traceability. Recorded connection from a requirement through its authorised source, owner, verification and accepting role.

Built-in conference room. Specialised Department term whose controlling meaning depends on the applicable authoritative definition and programme.

Chief of Mission. Official with statutory and policy responsibilities for United States Government executive-branch activities at an overseas mission, subject to stated exceptions.

Construction Security Plan. Project-specific controlled plan governing security measures, personnel, materials, surveillance, information and incidents during qualifying work.

Construction surveillance. Authorised observation and control of construction activity to protect the project and preserve required evidence.

Controlled access area. Department-defined area in which access is controlled for security purposes under the applicable policy.

Controlled criterion. Requirement whose distribution or content is restricted and supplied only through authorised channels.

Diplomatic Security. Department bureau responsible for diplomatic security programmes and related public organisational functions.

Disposition. Documented decision that closes, accepts, restricts or otherwise resolves a defined issue within an authorised scope.

Domain-interface matrix. Register linking shared physical elements to acoustic, electromagnetic, cyber, structural, fire and maintenance obligations.

Emanations countermeasures. Technical-security discipline addressing compromising electromagnetic or related emanations under the applicable authority.

Event-driven recommissioning. Review and testing initiated by a consequential change, incident or observed degradation rather than elapsed time alone.

Hold point. Planned stage beyond which work may not proceed until the specified condition has been observed and released.

Host building. Existing or surrounding facility providing structure, services, access and environmental conditions for a specialised room or module.

Integrated design review. Multidisciplinary examination of requirements and interfaces across design, construction, operations and security roles.

Least access. Information-management principle limiting access and detail to the amount required by an authorised role and purpose.

Minor construction and improvement. Department facility-work category that still requires security screening when it affects a protected boundary or state.

OBO. Bureau of Overseas Buildings Operations, the Department organisation responsible for diplomatic real-property programmes and lifecycle functions.

OSPB. Overseas Security Policy Board, associated with security standards applied under Department policy.

Project certification. Required governmental project action under the applicable construction-security framework, distinct from consultant certification.

Receiving zone. Defined space or location in which transmitted acoustic energy and listener access are evaluated.

Residual risk. Risk remaining after verified mitigation, stated with assumptions, monitoring and decision authority.

Secure conference room. Specialised Department term whose meaning and authorised use must be taken from the controlling source.

Security-minded information management. Lifecycle control of project information according to consequence, need, access, distribution and release.

SECCA. Secure Embassy Construction and Counterterrorism Act of 1999, as amended, forming part of the public statutory framework for diplomatic facilities.

Site Security Manager. Authorised project role coordinating construction-security implementation under the applicable Department framework.

Source-state register. Controlled record of human and electronic acoustic sources, levels, spectra, positions, settings and use conditions.

SRM. Sustainment, Restoration, and Modernization programme for lifecycle work on diplomatic facilities.

Technical due diligence. Structured investigation of existing or host-facility conditions before design and commitment.

Tiered record. Information product assigned an access and release level according to security consequence and project need.

Use decision. Competent-authority determination permitting a defined room function under stated conditions and restrictions.

Weakest-domain screen. Project analysis identifying the least complete or least controlled assurance domain without treating scores as governmental criteria.

Chapter 29. Broader United States Government, Intelligence Community, Department of Defense, and SCIF Public Doctrine

A Sensitive Compartmented Information Facility is an authorised physical and technical environment, not an acoustic product. Public Intelligence Community standards separate physical and technical-security policy from accreditation, reciprocal use, construction and operation. Department of Defense criteria provide public planning and design guidance for SCIF and SAPF projects. Acoustic protection is one layer within that integrated system.

The same four propositions govern. A tested assembly is not an installed room. An installed field result is not occupied speech-security performance. A favourable technical result is not accreditation. Each proposition requires its own evidence and the authorised official retains the institutional decision.

Figure 29-1. A SCIF is an authorised lifecycle system supported by policy, controlled criteria, project evidence and an accreditation decision. Author's original diagram.

29.1 SCIF as an authorised system rather than a room label

Public Intelligence Community doctrine treats the SCIF as a facility authorised for a defined activity under accredited conditions. The enclosure, access, technical systems, information handling, operations and continuing security form one system. A private room described as SCIF-like does not acquire that status through materials or ratings. [76][77][78][79]

Acoustic isolation participates through walls, doors, glazing, services, structure, background and listener access. Other disciplines address physical intrusion, electronic systems, compromising emanations,

76 MB-1177. The equations and numerical examples in this chapter are screening tools developed for teaching and project planning. They do not create universal sampling rates, acceptance thresholds, probabilities or evidentiary presumptions.
77 MB-1242. U.S. Department of Defense, ISO 10005:2018, ISO 10006:2017.
78 MB-1240. U.S. Department of Defense, UFGS 01 32 33.00 10, Photographic Documentation.
79 MB-0006. Acoustic Security Engineering for Secure Rooms, Revision 1.2C2, Chapter 33 cumulative treatment. Chapter 34 implements the requirement identifiers.

communications, cyber functions and personnel. Failure in one layer can matter even when another performs well. Within scif as an authorised system rather than a room label, the decisive analysis follows the complete source-path-receiver chain and records each interface capable of carrying pressure, force, information or measurement bias.

Project requirements should identify the sponsoring authority, accreditation path, facility category, authorised activities, controlled criteria, design reviewers, construction controls and continuing-use obligations. Commercial specifications should not imply government accreditation unless the actual authority has issued it. The design record for scif as an authorised system rather than a room label should translate those mechanisms into dimensions, products, tolerances, support conditions, inspection stages and named ownership.

The record should distinguish public doctrine from project-controlled requirements and should preserve the exact accreditation and reciprocal-use documents applicable to the site. Technical consultants should state their role and limitation. SCIF is not a synonym for high STC, soundproof or secure conference room. Evidence concerning scif as an authorised system rather than a room label should identify the exact observed unit, method, instrument chain, state, limitations and inference supported.

Worked example 29.1. Completion percentage versus controlling gate

An accreditation matrix contains 240 evidence cells. Two hundred thirty-eight are closed. The two open cells concern field speech-security testing and final authority disposition.

C is a dimensionless administrative completion ratio.

The matrix is 99.17 per cent complete, yet the facility is not ready for the claimed use because both remaining cells are controlling gates.

Percent completion does not weight consequence and cannot replace authority review.

29.2 ICD, ICS and technical specifications as a hierarchy

Public Intelligence Community directives and standards occupy different levels. Policy identifies authority and broad requirements. Standards describe physical, technical, accreditation or reciprocal-use functions. Technical specifications provide more detailed construction and management requirements within their authorised distribution and revision status. [80][81][82][83]

A project can become internally inconsistent when excerpts from different editions are combined, when a technical specification is treated as a public universal code, or when a local supplement is omitted. Changes in public versions do not disclose every controlled implementation decision. For icd, ics and technical specifications as a hierarchy, the mechanism must be traced from excitation through materials, supports, openings, controls and adjoining spaces rather than inferred from the trade name of one component.

The source register should identify document number, full title, edition, date, change, status, issuer, public-access condition, supersession and project use. The basis of design should cite the controlling edition rather

80 MB-0068. ASTM C840-25, ASTM C754-20.
81 MB-0008. Acoustic Security Engineering for Secure Rooms, Revision 1.2C2, Chapters 15 through 27 assembly and building-services source registers. Use the exact source and edition recorded in the chapter that owns the specific construction system.
82 MB-0068. ASTM C840-25, ASTM C754-20.
83 MB-0068. ASTM C840-25, ASTM C754-20.

than relying on remembered terminology or an undated checklist. Accordingly, the ICD, ICS and technical-specification hierarchy requires a controlled configuration with stable identifiers, coordinated details, access provisions and change triggers that remain usable after handover.

Design review should trace each requirement to its authority and should record conflicts for disposition. Superseded public documents can remain useful historically but should not silently control current work. A copied requirement without its edition, scope and authority is not a controlled requirement. Verification of icd, ics and technical specifications as a hierarchy should combine documentary reconciliation, direct observation and measurement without allowing one evidence class to substitute silently for another.

29.3 Accreditation, reciprocal use and technical evidence

Accreditation is a governmental determination based on a body of evidence, risk and authority. Reciprocal use permits another organisation to rely on an existing accreditation under defined conditions. Neither process is an acoustic measurement, and neither eliminates the need to understand later changes. [84][85][86][87]

Technical evidence can include design reviews, construction surveillance, test reports, inventories, certifications, waivers, as-built records and continuing inspection. A field acoustic report supports the proposition it measured. It cannot speak for electronic, access, personnel or information-system controls outside its scope. The engineering model for accreditation,

84 MB-0069. ASTM C919-24.
85 MB-0089. ASTM E336-25a, ASTM E2638-24.
86 MB-0073. ASTM E2174-24, ASTM E2393-24.
87 MB-0073. ASTM E2174-24, ASTM E2393-24.

reciprocal use and technical evidence should identify which physical variables change with frequency, operating state, loading, access, maintenance and environmental condition.

The acceptance plan should identify which evidence is supplied by each discipline, who reviews it and how open conditions are carried. Reciprocal-use decisions should verify that the authorised function and current configuration remain within the relied-upon baseline. Design development should assign every consequential interface in accreditation, reciprocal use and technical evidence to a responsible discipline and should resolve acoustic, structural, fire, accessibility and service obligations together.

Reports should avoid language suggesting that laboratory accreditation of a test facility equals accreditation of a SCIF. Laboratory competence and facility authorisation are distinct. A valid historic accreditation can become inapplicable after material change even when the certificate has not expired administratively. The acceptance record for accreditation, reciprocal use and technical evidence should preserve raw data, calibration, photographs, dimensions, processing and the decision rule needed for later reproduction.

29.4 Planning, site selection and adjoining-space control

Public DoD planning criteria emphasise early integration of mission, site, threat, access, utilities, structure, construction and lifecycle. Acoustic risk begins with location. Public corridors, service rooms, roofs, façades, plenums, shafts and neighbouring occupancies can create listener access and weak paths that no wall upgrade fully cures. [88][89][90][91]

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88 MB-1090. NFPA, Society of Fire Protection Engineers and adopted code or listed-system sources applicable to the project. Acoustic construction may not waive fire, smoke.
89 MB-0069. ASTM C919-24.
90 MB-0073. ASTM E2174-24, ASTM E2393-24.
91 MB-0085. ASTM E3157-25 and ASTM E3456-25, ASTM E3157-25, ASTM E3456-25.

Site geometry affects exterior exposure, structural continuity, mechanical routing and construction logistics. A room embedded in a controlled core differs fundamentally from one beside a public lobby or exterior loading area. Future tenancy and maintenance access can change the risk after occupancy. A credible treatment of planning, site selection and adjoining-space control distinguishes direct transmission, structural coupling, connected air paths, regenerated sound and observational uncertainty before selecting a remedy.

Planning should map source rooms, adjoining zones, listener access, service routes, structural paths, controlled circulation and likely future work. High-consequence rooms should avoid avoidable interfaces and should preserve space for robust doors, independent construction, silencers and inspectable transitions. The project documents should make planning, site selection and adjoining-space control buildable and inspectable by defining geometry, sequence, acceptable variation, substitute evidence and the point at which concealment is prohibited.

The planning evidence should include room data sheets, adjacency and access schedules, source-state assumptions and authority decisions. Deviations forced by an existing building should be explicit and tested. A superior wall cannot compensate for an uncontrolled accessible plenum or open service path. A favourable observation of planning, site selection and adjoining-space control remains bounded to the inspected population and measured state, while unseen conditions and untested modes associated with planning, site selection and adjoining-space control remain explicit limitations.

29.5 Construction criteria, assemblies and field equivalence

Public secure-facility criteria identify construction and management obligations, but acoustic performance still depends on exact assemblies and field execution. Gypsum, masonry, concrete, doors, glazing, ceilings, floors and services each have distinct mechanisms and evidence. A generic secure-facility detail does not replace tested or engineered configuration data. [92][93][94][95]

Field substitutions can change mass, stiffness, resonance, seals, frame geometry, support, fire rating, movement and maintenance. A component with the same headline sound rating may not be equivalent at interfaces. The acoustic weakest path can also migrate after a repair or upgrade. Analysis of construction criteria, assemblies and field equivalence begins by mapping the actual configuration, because small differences in geometry, restraint, continuity or software state can reverse the dominant path.

Specifications should combine performance requirements with prescriptions where mechanisms, life safety or inspectability cannot be inferred from a final number. Mock-ups and first-of-type units should include representative services and junctions before repetitive release. A robust specification for construction criteria, assemblies and field equivalence combines performance language with prescriptive detail wherever the mechanism cannot be verified from a final single-number test.

Construction surveillance should follow hold points, material identity, penetration registers, doorset records, photographs and nonconformance control. Field tests should remain linked to the as-built state. A passing

92 MB-0063. ASHRAE, Handbook. HVAC Applications, current public issuer information and recognised noise-and-vibration-control practice. Mechanical operation.
93 MB-0089. ASTM E336-25a, ASTM E2638-24.
94 MB-1124. Project-specific controlled criteria, approved submittals, listed systems.
95 MB-1240. U.S. Department of Defense, UFGS 01 32 33.00 10, Photographic Documentation.

whole-room result does not retrospectively prove every concealed component or waive unresolved code and authority issues. Testing of construction criteria, assemblies and field equivalence should report band data and operating conditions before any summary rating, so that background, flanking, drift and method scope can be examined.

Table 29-1. System, principal mechanism and required evidence.

System	Principal mechanism	Required evidence
SCIF as an authorised system rather than a room label	Acoustic isolation participates through walls, doors, glazing, services, structure, background and listener access	The record should distinguish public doctrine from project-controlled requirements and should preserve the exact accreditation and reciprocal-use documents applicable to the site
ICD, ICS and technical specifications as a hierarchy	A project can become internally inconsistent when excerpts from different editions are combined, when a technical specification is treated as a public universal code, or when a local supplement is omitted	Design review should trace each requirement to its authority and should record conflicts for disposition
Accreditation, reciprocal use and technical evidence	Technical evidence can include design reviews, construction surveillance, test reports, inventories, certifications, waivers, as-built records and continuing inspection	Reports should avoid language suggesting that laboratory accreditation of a test facility equals accreditation of a SCIF
Planning, site selection and adjoining-space control	Site geometry affects exterior exposure, structural continuity, mechanical routing and construction logistics	The planning evidence should include room data sheets, adjacency and access schedules, source-state assumptions and authority decisions
Construction criteria, assemblies and field equivalence	Field substitutions can change mass, stiffness, resonance, seals, frame geometry, support, fire rating, movement and maintenance	Construction surveillance should follow hold points, material identity, penetration registers, doorset records, photographs and nonconformance control
Technical security, TSCM, TEMPEST and acoustic boundaries	A conduit can be an acoustic path, a cable route and an electronic-security concern	Integrated reports should contain separate findings, methods and limitations for each discipline
Construction security and evidence under concealment	The evidence challenge is twofold	Final reconciliation should distinguish as-designed, as-submitted, as-installed, as-tested and as-authorised states

System	Principal mechanism	Required evidence
Field acoustic testing and speech-security assessment	Secure rooms can exceed the dynamic range of ordinary field measurements	The report should preserve raw data, configuration, calibration and processing
Operations, inspections and material change	The baseline should identify boundaries, penetrations, doors, glazing, services, masking, electronic equipment, software, pressure and authorised modes	Recommissioning should compare stable methods and states, investigate drift and update the authorised baseline after closure
Incidents, vulnerability findings and cautious attribution	Building defects, ordinary maintenance, software changes, user behaviour and malicious action can produce overlapping symptoms	Reports should distinguish observed condition, measured consequence, supported mechanism, untested alternatives, residual risk and authority disposition
Public-source restraint and private-sector claims	The public existence of controlled specifications does not make their contents available for inference	Publication and marketing should state bounded capability and avoid badges or phrases suggesting certification beyond the evidence

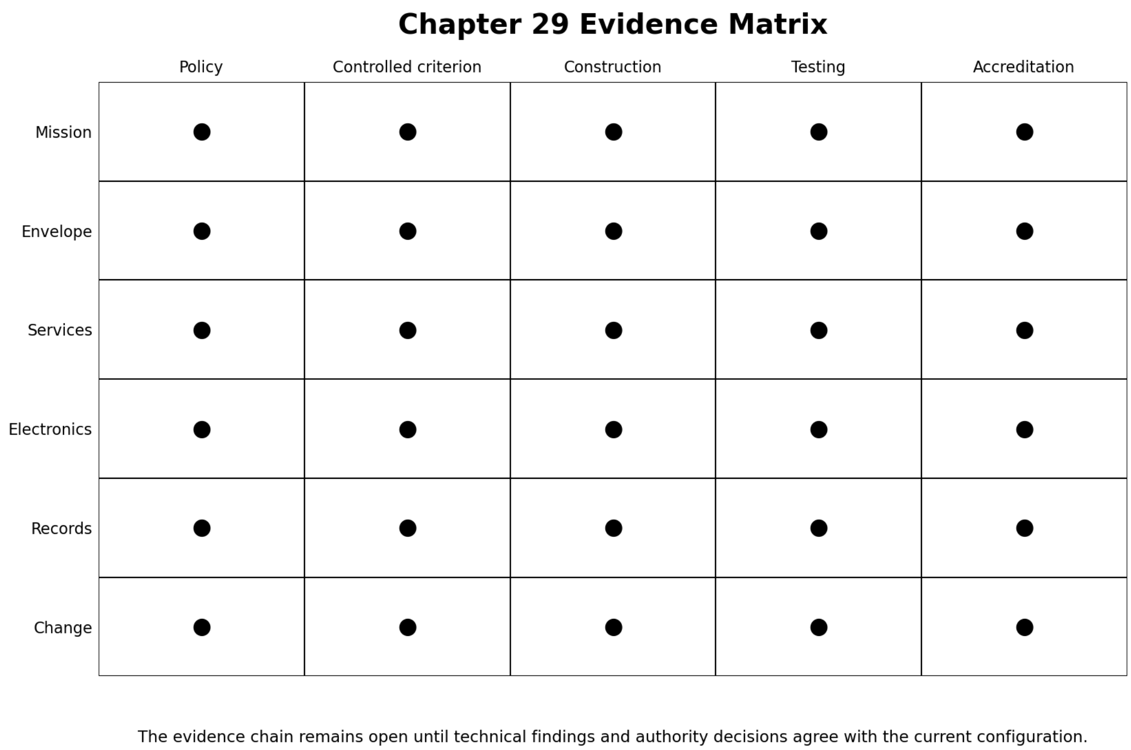

Figure 29-2. The evidence chain remains open until technical findings and authority decisions agree with the current configuration. Author's original diagram.

29.6 Technical security, TSCM, TEMPEST and acoustic boundaries

Public doctrine recognises several technical-security disciplines. Acoustic isolation addresses airborne and structure-borne speech transfer. TSCM addresses authorised examination for technical surveillance threats. TEMPEST or EMSEC addresses compromising emanations. Cybersecurity addresses systems and networks. These disciplines share physical interfaces but do not substitute for one another. [96][97][98][99]

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96 MB-1177. The equations and numerical examples in this chapter are screening tools developed for teaching and project planning. They do not create universal sampling rates, acceptance thresholds, probabilities or evidentiary presumptions.
97 MB-1094. ISO/IEC 27037:2012.
98 MB-0936. ISO 19650-1:2018, ISO 19650-2:2018.
99 MB-1094. ISO/IEC 27037:2012.

A conduit can be an acoustic path, a cable route and an electronic-security concern; a display can excite a wall and contain microphones or radios; a metallic enclosure can affect both structural vibration and electromagnetic performance; coordination is necessary, but conclusions must remain bounded. The controlling behaviour of technical security, tscm, tempest and acoustic boundaries is system dependent and cannot be reduced to one catalogue value when adjacent construction and services participate in the measured response.

The project should identify responsible technical authorities, information-sharing rules, inspection sequence and interface details. Acoustic changes should be screened for electronic consequences, and electronic changes should be screened for mounts, penetrations, source level and room state. Procurement and submittal review should preserve the tested or approved identity of technical security, tscm, tempest and acoustic boundaries, including the features whose alteration would invalidate comparison with the supporting evidence.

Integrated reports should contain separate findings, methods and limitations for each discipline; a combined executive summary should not erase those distinctions; no single instrument or inspection can certify the complete technical-security posture; where technical security, TSCM, TEMPEST and acoustic boundaries are evaluated by intervention, the record should describe collateral changes and restoration duties before attributing the observed difference to one mechanism.

29.7 Construction security and evidence under concealment

High-assurance construction must preserve knowledge of conditions that become inaccessible. Resilient devices, cavity fill, anchors, wall heads, fire-stops, ducts and cable routes disappear behind finishes. Public criteria and project-controlled procedures may impose access, personnel, material and observation controls beyond ordinary quality assurance. [100][101][102][103]

The evidence challenge is twofold. The project needs reliable observations, and the observations themselves may be sensitive; a photograph without location or scale is weak; a comprehensive unrestricted model can be overexposed; controlled repositories and stable identifiers permit technical usefulness with limited distribution. For the question addressed in section 29.7, construction security and evidence under concealment are examined as a time-varying network whose inputs, boundaries and receiver conditions must all remain explicit.

The surveillance plan should define personnel, escorts, approved devices, hold points, sampling, nonconformance, image control, chain of custody, redaction and handover. Missed hold points should trigger an alternative-evidence plan rather than retrospective signature. For construction security and evidence under concealment, the room data sheet and requirement matrix should state source states, adjoining access, operating modes, lifecycle duties and the accepting authority.

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100 MB-1177. The equations and numerical examples in this chapter are screening tools developed for teaching and project planning. They do not create universal sampling rates, acceptance thresholds, probabilities or evidentiary presumptions.
101 MB-0946. ISO 9001:2015, ISO 10005:2018.
102 MB-0946. ISO 9001:2015, ISO 10005:2018.
103 MB-0933. ISO 19011:2026.

Final reconciliation should distinguish as-designed, as-submitted, as-installed, as-tested and as-authorised states. Unverified concealed conditions should remain marked as such. Security restrictions do not justify ceremonial inspection. They require better planned controlled inspection. The dossier for construction security and evidence under concealment should distinguish as-designed, as-submitted, as-installed, as-tested, as-authorised and as-operated states.

29.8 Field acoustic testing and speech-security assessment

A SCIF project can use laboratory reports, field sound-isolation tests, door tests, duct tests and occupied speech-security methods. Each answer differs. The test plan should be selected from the authorised question and should state frequency range, source, receiver, background, dynamic range, correction, uncertainty and decision rule. [104][105][106][107]

Secure rooms can exceed the dynamic range of ordinary field measurements. Background may censor high isolation. Local weak paths may be missed by room averages. Maximum-effort speech, installed conferencing and quiet states can differ from standardised source conditions. The physical inquiry into field acoustic testing and speech-security assessment separates what carries energy from what merely appears defective, thereby preserving alternative hypotheses until discriminating evidence is obtained.

Testing should combine standardised evidence with diagnostic local work where authorised. Diagnostic modifications and temporary seals must be

104 MB-0089. ASTM E336-25a, ASTM E2638-24.
105 MB-0931. ISO 16283-1:2014, ISO 12999-1:2020.
106 MB-0966. JCGM 100:2008, JCGM 106:2012.
107 MB-0089. ASTM E336-25a, ASTM E2638-24.

disclosed and kept separate from formal acceptance results. Critical listener positions should be defined by access analysis, not convenience. The design team should provide maintainable routes, inspection access and authorised replacement criteria so that later work on field acoustic testing and speech-security assessment does not silently alter the boundary.

The report should preserve raw data, configuration, calibration and processing. The authority decides how the result supports accreditation or use. A single-number rating is a summary, not the full evidence and not an accreditation decision. Inspection and measurement of field acoustic testing and speech-security assessment should be scheduled while the controlling condition is still observable, with missed hold points treated as missing evidence rather than acceptance.

Worked example 29.2. Guarded field decision

A field result is 51.8 dB against a 50 dB project requirement. Expanded measurement uncertainty is 1.5 dB, and the pre-agreed rule requires result minus uncertainty to meet the limit.

D is the guarded decision quantity. The 1.5 dB value covers only contributors represented in the uncertainty model.

The guarded quantity is 50.3 dB and meets the stated numerical rule.

Configuration uncertainty, untested states and authority conditions remain separate from the measurement uncertainty.

29.9 Operations, inspections and material change

Accredited facilities remain vulnerable to configuration drift. New cables, display mounts, door hardware, ceiling work, fire-protection changes, software updates, furniture anchors and emergency repairs can invalidate assumptions. Continuing inspection and change control are therefore technical controls. [108][109][110][111]

The baseline should identify boundaries, penetrations, doors, glazing, services, masking, electronic equipment, software, pressure and authorised modes. Change categories should be tied to the paths and propositions they can affect. Like-for-like replacement requires evidence. Evaluation of operations, inspections and material change requires a scale-appropriate model, from local joint or support behaviour through room-level and whole-building consequences.

Work permits should screen boundary impact before execution and should specify surveillance, photographs, testing and authority review. Emergency work requires prompt retrospective reconciliation. Periodic inspections should focus on dynamic and accessible elements and on known failure mechanisms. Details governing operations, inspections and material change should be coordinated in three dimensions, with movement, supports, penetrations, terminations and control states shown rather than left to site improvisation.

Recommissioning should compare stable methods and states, investigate drift and update the authorised baseline after closure. Superseded evidence should remain traceable. Maintenance that restores appearance but not configuration is not technical closure. Reports on operations, inspections and material change should separate observation, calculation, interpretation, residual alternatives and competent-authority disposition.

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108 MB-0931. ISO 16283-1:2014, ISO 12999-1:2020.
109 MB-0966. JCGM 100:2008, JCGM 106:2012.
110 MB-0950. ISO/IEC 17025:2017.
111 MB-0070. ASTM E1186-22.

29.10 Incidents, vulnerability findings and cautious attribution

An incident may begin with audible speech, an unauthorised cable, a displaced ceiling tile, failed masking or unexplained test degradation. These observations require prompt control and evidence preservation, but they do not prove hostile activity, exploitation or compromise. [112][113][114][115]

Building defects, ordinary maintenance, software changes, user behaviour and malicious action can produce overlapping symptoms. Premature attribution can damage the investigation and expose individuals or organisations to unsupported claims. The inquiry should maintain competing hypotheses and use controlled contrasts. The mechanism associated with incidents, vulnerability findings and cautious attribution should be stated in measurable terms, including the quantities, directions, frequency bands and operational states that could control the result.

Immediate actions may include suspending sensitive use, securing adjoining spaces, preserving logs, freezing configuration and notifying responsible officials. Investigation should proceed from whole-system baseline to local diagnosis and targeted opening only when necessary. The selected treatment of incidents, vulnerability findings and cautious attribution should remain effective under credible extremes, not merely under the convenient condition used for an early demonstration.

Reports should distinguish observed condition, measured consequence, supported mechanism, untested alternatives, residual risk and authority disposition. Legal and security review may govern distribution. A

112 MB-1244. U.S. Department of Defense, ISO 19650-2:2018, ISO 19650-3:2020.
113 MB-1051. ISO/IEC 27037:2012.
114 MB-1051. ISO/IEC 27037:2012.
115 MB-1051. ISO/IEC 27037:2012.

vulnerability is not proof of exploitation, and a nonconformance is not proof of information loss. A result for incidents, vulnerability findings and cautious attribution cannot be extended automatically to another room, product, geometry, season or software state without an explicit equivalence analysis.

29.11 Public-source restraint and private-sector claims

Commercial designers often borrow government terminology to describe high-security rooms. Public doctrine can inform disciplined practice, but a private project should not claim SCIF accreditation, reciprocal use or governmental approval without the actual authority and process. [116][117][118][119]

The public existence of controlled specifications does not make their contents available for inference. Procurement fragments, unofficial summaries, historic documents and product literature can produce a plausible but inaccurate composite. This is especially dangerous where criteria change by mission, authority and local threat. In public-source restraint and private-sector claims, interfaces ordinarily deserve more scrutiny than uniform fields because movement, access, fasteners, penetrations and later work concentrate uncertainty there.

Private requirements should be written in measurable engineering terms, with explicit authority and source status. Where government use is anticipated, the sponsoring authority should provide the controlling criteria through proper channels. Where public-source restraint and private-sector claims depend upon workmanship or configuration, first-of-type construction and explicit hold points should precede repetitive release.

116 MB-1244. U.S. Department of Defense, ISO 19650-2:2018, ISO 19650-3:2020.
117 MB-1246. U.S. Department of Defense, UFGS 01 91 00.15, Building Commissioning.
118 MB-0936. ISO 19650-1:2018, ISO 19650-2:2018.
119 MB-1154. Royal Institute of British Architects, RIBA Plan of Work 2020.

Publication and marketing should state bounded capability and avoid badges or phrases suggesting certification beyond the evidence. Case studies should distinguish synthetic examples from governmental facilities. Precision in institutional language is part of technical security and professional ethics. Lifecycle evidence for public-source restraint and private-sector claims should include baseline indicators, maintenance criteria, event triggers and the records required to detect later drift.

Table 29-2. Release gate.

Gate	Controlling question	Minimum record	Failure response
Requirement	What outcome or bounded condition is required?	Source, owner, state and decision authority	Clarify or suspend the affected work
Configuration	What exact physical and operating state is represented?	Drawings, submittals, asset and route identifiers	Reconcile discrepancies before acceptance
Inspection	What conditions were directly observable before concealment?	Hold-point record, measurements and images	Open, reconstruct or carry a stated limitation
Measurement	What quantity was measured, where, when and with what uncertainty?	Raw data, calibration, method, state and processing	Correct the method or repeat the test
Authority	Who may accept, condition, restrict or reject the result?	Signed disposition and limitations	Do not represent technical review as authorisation
Lifecycle	What later change can invalidate the result?	Baseline, maintenance and retest triggers	Reopen review and update the controlled record

29.12 Sponsoring authority, CSA, AO, SSO, and engineering roles

A SCIF project succeeds only when institutional roles are explicit; the sponsoring organisation defines mission need and funds the work. The cognizant security authority interprets the applicable security framework; the accrediting official decides whether the completed facility may support the proposed use; the Special Security Officer manages operational SCI controls; designers, contractors, commissioning specialists and acoustical engineers create evidence within that chain, but none may silently assume the governmental decision role. [120]

Responsibility should be traced by decision, not merely by trade. A wall detail may involve the architect, structural engineer, fire-protection engineer, electrical designer, technical-security specialist and accrediting representative. A commissioning result may be technically correct yet unusable if the test state, witness, instrument chain or authority was not agreed. The project matrix should name who authors, reviews, verifies, accepts, conditions and archives each consequential requirement.

The practical control is a signed responsibility and evidence matrix linked to the requirements register; it should include delegated authorities, alternates, response periods, stop-work powers and escalation routes; role changes during a long programme require formal transfer. A consultant's report should state the precise proposition supported and the official to whom the evidence is submitted; this prevents technical confidence from being mistaken for accreditation or reciprocal-use authority.

Role definition should also be tested against foreseeable disruptions; a security officer may be unavailable during a concrete placement, an accrediting representative may change during commissioning, or the design authority may discover that a subcontractor has altered a concealed detail. The project should pre-authorise substitutes only where delegation is lawful, record the limits of delegated judgment, and preserve a route to the original decision owner; a useful exercise is to select several irreversible activities and rehearse who may stop work, who may accept temporary protection,

120 MB-1042. National Institute of Building Sciences, Whole Building Design Guide public building-commissioning resources, consulted 13 August 2026. Commissioning and turnover should preserve owner requirements.

who may order opening, and who may authorise restart. This exercise exposes gaps that a conventional organisation chart cannot reveal; it also separates administrative notification from technical acceptance. A person who must be informed is not necessarily the person who may approve the resulting risk. The final record should therefore preserve both the technical chain and the governmental decision chain, including dates, conditions, dissenting views, and unresolved dependencies.

Table 29-3. Authority, role, evidence, and decision boundary.

Role	Primary function	Typical evidence	Boundary
Sponsoring organisation	Defines mission and funds work	Mission statement, programme decision	Does not replace cognizant authority
Cognizant security authority	Interprets applicable security framework	Criteria, review comments, dispositions	May rely on controlled criteria
Accrediting official	Makes facility-use decision	Accreditation package and decision	Does not perform every engineering task
Special Security Officer	Manages SCI operations	Procedures, access and inspection records	Does not issue construction evidence
Engineering team	Designs, analyses and tests	Drawings, calculations, reports	Does not accredit facility

Worked example 29.3. Responsibility-link coverage

A responsibility matrix contains 60 consequential decisions. Fifty-four identify an originator, reviewer, verifier and accepting official. Let C_r be the responsibility-link coverage, N_l the fully linked decisions and N_t the total decisions.

The matrix is 90.0 per cent linked, leaving six decisions without a complete authority chain. Those six should be closed before concealment or formal acceptance.

The ratio measures documentary coverage only. It does not determine whether the assigned people possess the legal authority, competence, clearance or programme knowledge required for the decision.

29.13 ICD, ICS, technical-specification, and local-criteria configuration control

Public Intelligence Community policy is layered; a directive establishes policy and responsibility. A standard develops specific institutional requirements; the public technical specification supplies more detailed construction and management provisions; local supplements, programme direction and project-controlled criteria can add obligations; a defensible design therefore begins with a source hierarchy rather than a folder of undated excerpts. [121]

Configuration control should record identifier, title, date, change, status, distribution condition, supersession, responsible authority and project applicability. The register must also distinguish public text from protected implementation criteria. Combining a current UFC, an older checklist and a copied paragraph from a superseded technical specification can create an internally plausible but non-authoritative composite. The defect is difficult to detect after drawings and submittals have inherited the mixture.

Every requirement should carry a stable source key and revision. When a source changes, the team evaluates technical effect instead of performing indiscriminate word replacement. Decisions should state whether the project remains on its authorised baseline, adopts the revision, or obtains a formal disposition. Archived versions remain necessary for forensic reconstruction, but the design basis must identify which version controlled each issued package and field installation.

A source baseline becomes especially fragile when a project spans several fiscal years; design packages can be issued under one technical specification, procured under a later UFC, and commissioned after a

121 MB-0937. ISO 19650-6:2025.

departmental manual changes; the correct response is not automatic adoption or automatic rejection. The team should perform a disciplined change-impact analysis by requirement, system, drawing, submittal, inspection point, test method, cost, schedule, and approval authority; each difference should be classified as editorial, clarifying, more restrictive, less restrictive, technically incompatible, or outside project scope. Where a revised public source refers to a protected implementing criterion, the record should state that the protected determination remains with the cognizant authority. A redline without an applicability decision is insufficient. The project needs an auditable disposition showing which baseline governed each physical feature and why any later change did or did not require redesign, retesting, supplemental surveillance, or formal re-approval.

Table 29-4. Public source hierarchy and configuration-control fields.

Layer	Illustrative source	Control field	Failure if omitted
Directive	ICD 705	Identifier, date, authority	Policy and responsibility become ambiguous
Standard	ICS 705-01 or 705-02	Edition, status, scope	Accreditation and construction functions can be conflated
Technical specification	SCIF Technical Specification v1.5.1	Revision and distribution condition	Detailed criteria may be mixed across versions
Facilities criterion	UFC 4-010-05	Applicability and project edition	Planning guidance can be mistaken for accreditation
Local or programme criterion	Authority-issued project material	Owner and protected disposition	Public text may be overextended

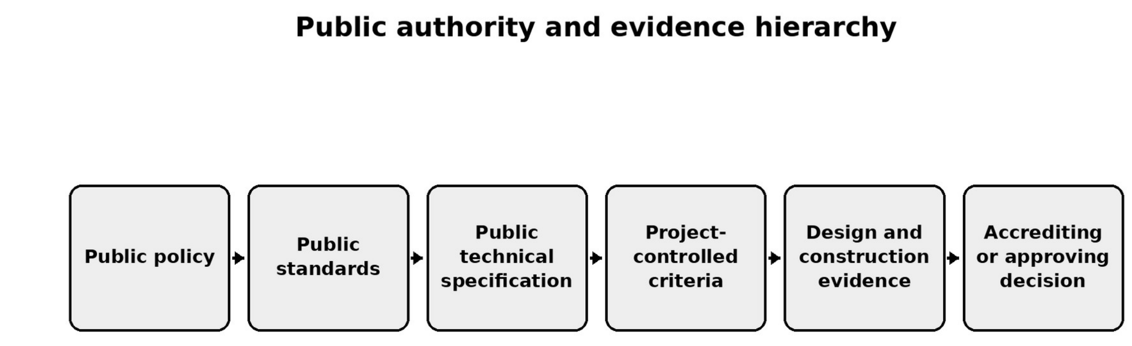

Figure 29-3. Public doctrine flows from policy through standards and technical specifications into project-controlled criteria, evidence and a competent-authority decision; protected criteria remain outside the public reconstruction. Author original diagram.

Worked example 29.4. Source-configuration integrity

A source register contains 48 controlling entries. Forty-four have exact identifiers, dates, status and project dispositions. Four are labelled only current version. Let C_s be source-configuration integrity.

The register has 91.7 per cent verified configuration integrity. The four unresolved entries should not control procurement or acceptance until their status is resolved.

The screening ratio does not prove that the cited requirements were correctly interpreted or that protected project criteria have been completely incorporated.

29.14 SCIF and SAPF planning under UFC 4-010-05

UFC 4-010-05 supplies a public bridge between security authority and the planning, design and construction professions. Its principal value is organisational. It alerts planners, programmers, architects and engineers to the published regulatory framework, the need for early security participation and the consequences of treating a secure facility as a late interior fit-out. It does not replace the controlling Intelligence Community or SAP authority. [122]

Planning should establish mission, facility type, capacity, location, construction strategy, communications, technical-security interfaces, access, utilities, life safety, schedule and cost before design hardens; acoustic security is affected by each choice; a remote service room can reduce accessible listener positions. An independent structural bay can reduce flanking; adequate ceiling depth can permit silencers and inspectable transitions. Conversely, a late room insertion can create unavoidable shared plenums and compromised doors.

The planning record should expose uncertainty rather than bury it in contingency. Existing-building surveys, controlled criteria, host-system capacity, temporary operations and long-lead secure components should be represented as decision gates. Cost estimates should include surveillance, mock-ups, destructive verification, commissioning, retesting, authority review and lifecycle documentation. A project that funds walls but not evidence is not fully programmed.

Programme planning should model evidence production as a resource-loaded workstream; surveillance staff, approved storage, secure communications, calibration services, witness availability, test sources, temporary barriers, destructive inspection, and correction cycles all consume time and money. They also interact. A late delivery of a specialised

122 MB-1237. U.S. Department of Defense, UFC 4-010-05.

door can delay enclosure testing, which can delay systems commissioning, which can compress authority review into an unsafe period; the master schedule should therefore identify evidence predecessors and not merely construction predecessors. An acoustic test cannot close a deficiency if the tested door hardware differs from the accepted submittal; a photograph cannot prove seal depth if the scale and location are missing. A commissioning report cannot support use if the tested operating state excludes the quietest credible condition. By assigning evidence maturity to each milestone, the programme can distinguish physical completion from demonstrable completion and prevent nominal substantial completion from obscuring unresolved security work.

Worked example 29.5. Planning-risk reserve

A planning team identifies eight major risk categories with estimated cost exposures of 2, 3, 1, 4, 2, 5, 3 and 2 cost units. Mitigation reduces them to 1, 1, 1, 2, 1, 2, 1 and 1. Let R_0 and R_m be the unmitigated and mitigated sums.

The planned controls reduce the screening exposure by 12 units, or 54.5 per cent. The remaining ten units require budget and decision ownership.

The units are project-defined and not governmental risk scores. The arithmetic supports transparent programming but cannot replace a formal threat or security assessment.

29.15 Facility categories, fixed, temporary, mobile, co-use, and joint-use states

Secure-facility doctrine recognises that not every authorised environment has the same physical permanence or institutional relationship. Fixed facilities, temporary secure working areas, mobile configurations, compartmented areas, co-use arrangements and joint-use facilities present different evidence needs. The category affects construction, inspection, operating limitations, duration, restoration and the authority required for continued use. [123]

The engineering danger lies in category drift; a temporary configuration may become semi-permanent through repeated extension; a co-use arrangement may accumulate systems and users beyond the accredited baseline; a mobile enclosure may be relocated onto a floor, power system or HVAC connection that was never evaluated. Each state should therefore be treated as a complete configuration, not merely as the same room in a different administrative file.

The facility register should identify authorised activities, information domains, users, sponsoring organisations, operating hours, physical boundaries, adjoining access, systems, expiry or review date and restoration obligations. When a category changes, the team should revisit source-state assumptions, listener access, services, field testing, technical-security review and accreditation evidence. Administrative convenience must not create unexamined physical equivalence.

Table 29-5. Facility and use-state taxonomy.

State	Principal variable	Required record	Re-evaluation trigger
Fixed facility	Permanent structure and systems	Accredited baseline	Material construction or mission change
Temporary configuration	Duration and restoration	Expiry, restrictions, closure plan	Extension or altered use
Mobile or relocatable	Host interfaces and transport	Location-specific equivalence	Relocation or reassembly
Co-use	Multiple authorised users	Agreement and configuration	New organisation or system

123 MB-0936. ISO 19650-1:2018, ISO 19650-2:2018.

State	Principal variable	Required record	Re-evaluation trigger
Joint-use	Shared authority and governance	Joint decision record	Responsibility or mission change

Worked example 29.6. Credible state-combination count

A facility has four occupancy states, three HVAC states, two masking states and two access states. Let N_c be the number of discrete combinations if every state can coexist.

Forty-eight combinations exist before equipment, door and emergency states are added. The commissioning plan should select the combinations that are both credible and consequential.

The product assumes independent state variables. Interlocks or operating rules may remove combinations, while hidden software states can add others.

29.16 Site selection, adjacency, controlled perimeter, and listener access

Site selection determines the geometry of exposure. A secure room within a controlled core differs from one beside a public corridor, tenant suite, roof, loading dock or mechanical penthouse. Listener access can occur through legal occupancy, maintenance rights, landlord access, shared utilities or future tenancy. The acoustic model should therefore begin with access zones and time-dependent opportunity, not only with construction assemblies. [124]

Adjacency analysis should include plan, section and service topology; a remote room may be connected by a duct, pipe riser, cable tray, raised floor or structural frame; exterior walls add weather, traffic, façade maintenance

124 MB-0936. ISO 19650-1:2018, ISO 19650-2:2018.

and off-site observation. Rooftop equipment can carry vibration and create access routes; basement locations may simplify external exposure while increasing shared utility and flood risk. No single location attribute is universally superior.

A site-selection memorandum should compare candidate locations using mission, access, constructability, lifecycle, emergency response and measured or modelled acoustic consequence. Uncertainty should be stated where adjoining rights or future development are unknown. The chosen location should preserve physical room for robust interfaces, inspection and later maintenance. A marginal location should not be rescued on paper by an assumed listener who never approaches the weakest path.

Listener-access analysis should be spatial, temporal, and institutional; an exterior façade may appear remote during ordinary occupation yet become accessible from scaffolding, adjacent roofs, maintenance cradles, temporary event structures, or a future tenancy; a service corridor may be controlled during the day but opened to cleaners or emergency contractors after hours. The analysis should map who can occupy each adjoining zone, for how long, with what tools, under what supervision, and in which plant states; it should also identify whether access can be gained without creating an observable anomaly. A technically strong partition beside an uncontrolled riser or ceiling void may provide less assurance than a modest partition beside a continuously controlled buffer. These conclusions should be expressed as bounded scenarios, not universal classifications. Site and adjacency evidence should be updated when leases, maintenance contracts, roof access, neighbouring construction, or public circulation patterns change.

Worked example 29.7. Accessible-zone exposure

Four adjoining zones have accessible boundary lengths of 6, 9, 4 and 1 metres [19.7, 29.5, 13.1 and 3.3 feet]. The total protected perimeter is 28 metres. Let C_a be the fraction adjoining accessible zones.

Approximately 71.4 per cent of the perimeter adjoins accessible zones. That geometry supports prioritising those boundaries, but not ignoring the remaining 28.6 per cent.

Boundary length is not a risk metric. Source level, construction, listener distance, access duration and connected paths remain essential.

29.17 Existing-building due diligence and hidden-path reconnaissance

Existing buildings preserve construction history in layers. Abandoned ducts, speaking tubes, chase walls, floor trenches, conduit stubs, hollow columns, concealed glazing pockets and previous tenant alterations can connect spaces that appear independent on current drawings. Due diligence should combine records, visual survey, non-destructive examination and controlled testing. Any one method can miss a consequential path. [125]

The survey should reconcile original drawings, renovation sets, maintenance records, firestop surveys, cable databases and site observations. Borescopes, thermal imaging, airflow indicators, vibration measurements and local acoustic excitation can support diagnosis when used within their limitations. Destructive openings should be targeted, authorised and documented. The purpose is not to search indiscriminately, but to test a physical path hypothesis.

125 MB-0338. ASTM International, ASTM E90-23.

Findings should be entered into a route and uncertainty register. Each route receives an origin, destination, geometry, access condition, evidentiary basis and disposition. Unverified areas remain explicit. A clean finish or recent renovation is not evidence of complete closure. Existing-building equivalence should be demonstrated at interfaces and concealed transitions, where workmanship and undocumented change concentrate uncertainty.

Existing-building reconnaissance should use converging methods because no single record is complete; archive drawings reveal intended construction, but renovations may have changed routes and junctions; visual inspection reveals accessible conditions, but finishes conceal cavities; non-destructive measurements can identify anomalies, but they rarely identify mechanism without corroboration. Selective opening supplies direct evidence, but it samples only a limited area. The survey plan should therefore combine document review, interviews, route tracing, dimensional checks, acoustic measurements, vibration observations, borescope work, thermal or optical assistance where justified, and carefully selected openings. Findings should be plotted against a common room and path model. Contradictions are valuable. A duct shown as abandoned may carry air; a wall shown as full height may terminate above a ceiling; a sealed sleeve may contain an unrecorded cable. The record should distinguish observed fact, measured response, inferred construction, and unresolved hypothesis so later designers do not treat conjecture as as-built truth.

Worked example 29.8. Hidden-path sampling coverage

A survey identifies 80 concealed interface zones. Records and non-destructive checks provide adequate evidence for 62, while targeted openings verify another 10. Let C_h be evidentiary coverage.

The programme has evidence for 90.0 per cent of identified zones. Eight remain unresolved and should be carried as limitations or opened before acceptance.

Coverage does not weight consequence. One unresolved high-connectivity shaft can matter more than many verified low-consequence joints.

29.18 Structural, seismic, blast, and acoustic interface control

Secure construction must remain structurally safe while limiting unintended vibration and air paths. Seismic joints, blast-resisting frames, progressive-collapse ties, slab edges, roof diaphragms and equipment anchorage can create rigid connections across otherwise isolated assemblies. Acoustic detailing cannot remove required load paths, and structural detailing cannot assume that a small joint is acoustically irrelevant. [126]

Coordination should distinguish normal-operation contact from extreme-event restraint. Snubbers and seismic stops may remain clear during normal service but engage under prescribed displacement. Penetration sleeves and head-of-wall joints require movement capacity, fire performance and acoustic closure. Heavy doors and modular enclosures impose concentrated loads and can change floor deflection, frame alignment and seal compression.

126 MB-0278. ASTM International, ASTM E336-25a.

The design model should record stiffness, mass, damping, support geometry, movement range and inspection access. Field verification should check actual clearance and restraint, not only drawing dimensions. After an earthquake, blast event, major structural repair or unexplained door misalignment, the facility should be inspected and selectively recommissioned. Apparent structural survival does not establish preserved acoustic or technical-security performance.

Multidisciplinary interface review should be conducted at the physical junction rather than by discipline alone; a head-of-wall detail can simultaneously carry drift, fire-resistance, smoke, acoustic, inspection, and construction-surveillance obligations; a resilient connection can improve vibration isolation yet fail under required seismic movement or become short-circuited by a brace. A blast-resistant frame can create a stiff structural bridge; the review should state normal clearances, extreme movement, tolerances, installation sequence, inspection access, permissible contact, and post-event examination; calculations should separate service-level behaviour from extreme-event behaviour. An assembly may be permitted to engage a restraint during an exceptional event while remaining separated during ordinary use; that distinction must be visible in drawings and field criteria; otherwise installers may close a designed gap for cosmetic reasons, or reviewers may reject a necessary safety restraint because its normal operating state was never explained.

Table 29-6. Building-system interface register.

Interface	Required performance	Evidence	Lifecycle concern
Structure to isolated room	Safe support with bounded normal contact	Calculations, clearances, inspection	Settlement, seismic event, added loads

Interface	Required performance	Evidence	Lifecycle concern
Door to wall	Listing, egress, accessibility and repeatable seal	Submittal, mock-up, field test	Wear, closer adjustment, hardware replacement
Duct to boundary	Airflow, fire, pressure and acoustic control	Shop drawing, inspection, functional test	Rebalance, filter and damper work
Power and data penetration	Safety, firestop, security and capacity	Route register, photographs, test	New cables and equipment refresh
Control system to network	Defined cyber and operational state	Architecture, configuration export, logs	Firmware and remote-access change

Worked example 29.9. Isolation natural-frequency screen

An equipment platform has supported mass m = 900 kg [1,984 lb] and total vertical stiffness k = 1.44 MN/m [8,222 lbf/in]. Let f_n be the undamped natural frequency.

The 6.37 Hz value supports comparison with forcing frequencies and required static deflection. It does not by itself prove acceptable isolation.

Real mounts are damped, multi-directional and load-sensitive. Piping, conduits, seismic restraints and floor flexibility can short-circuit the calculated isolation.

29.19 Architectural envelope, doors, glazing, and weakest-path doctrine

A secure room is governed by the combined boundary rather than by its strongest wall. Doors, frames, seals, thresholds, glazing, access panels, wall heads, base joints and small penetrations operate in parallel. As the opaque wall improves, local elements and installation tolerances become progressively more important. A headline partition rating therefore cannot represent the complete room. [127]

127 MB-0237. ASTM International, ASTM E2638-24.

The envelope schedule should identify each element, tested or calculated basis, dimensions, frame, support, perimeter treatment, hardware, operating state and inspection method. Door closers, latches and automatic operators must satisfy egress and accessibility while maintaining repeatable seal compression. Glazing systems require attention to pane construction, frame stiffness, bite, gaskets, anchors, surrounding wall and façade continuity.

Acceptance should combine room-average methods with local investigation where authorised. A favourable broad-band result can conceal a narrow high-frequency leak at a latch, or a low-frequency structural path through a frame. Remediation should target the controlling path and then repeat the relevant whole-room test. Adding material to a non-controlling wall is expensive theatre, not engineering closure.

Worked example 29.10. Composite transmission screen

A boundary contains 45 m2 of wall with transmission loss 58 dB and a 3 m2 door system with transmission loss 42 dB. Let tau_i = 10^(-R_i/10) and R_c be the area-weighted composite value.

The 3 m2 door reduces the idealised composite value to about 53.5 dB, despite the much larger high-performing wall area.

The calculation excludes flanking, leakage, receiving-room conditions and frequency detail. It is a screening model, not a field rating or accreditation result.

29.20 HVAC, duct-borne speech, cross-talk, and pressure-state control

Ventilation systems are both life-support systems and acoustic networks. Supply and return ducts can carry speech, permit cross-talk, break out through duct walls, regenerate flow noise and create pressure states that alter door operation. Fire and smoke dampers, access doors, flexible connectors, controls and maintenance clearances add interfaces that must remain inspectable and code-compliant. [128]

The design should trace every air path from source room to terminal, plenum, shaft and neighbouring zone. Silencer selection requires insertion loss, self-noise, pressure drop, airflow, contamination, fire requirements and maintainability. Transfer air is particularly consequential because it deliberately connects rooms. A shared return plenum can defeat otherwise strong partitions unless the complete route is treated.

Commissioning should test representative air states, minimum and maximum flow, night setback, emergency operation, smoke-control interaction and credible equipment failures. Acoustic measurements should record fan speed, damper position, grille condition, filter loading and room pressure. Later rebalance or filter replacement can change both background sound and transmitted speech, requiring controlled review rather than an assumption of harmless maintenance.

HVAC assurance is strongest when air-path geometry, mechanical operation, fire protection, controls, and occupied acoustic states are tested together; a silencer selected from catalogue insertion loss may perform differently after transition losses, regenerated noise, flow, leakage, and

128 MB-0871. International Organization for Standardization, ISO 16283-1:2014.

installation constraints are included. A damper may satisfy fire requirements yet create a direct speech path when open; a pressure-control sequence may alter door force and seal compression; a night setback may reduce background noise and fan masking precisely when adjoining spaces are most accessible. The commissioning plan should therefore combine airflow and pressure measurements with frequency-resolved acoustic observations across representative damper, fan, filter, and door states. It should preserve balancing settings, control sequences, access-panel status, and microphone positions. Later maintenance should trigger comparison with this baseline whenever filters, fans, dampers, controls, silencers, flexible connectors, or access doors are changed.

Worked example 29.11. Duct attenuation budget

A duct route includes a lined section with 12 dB attenuation, a silencer with 24 dB insertion loss and two elbows contributing 3 dB each. Regenerated noise and flanking are excluded. Let A_t be the arithmetic screening attenuation.

The idealised route provides 42 dB of component attenuation before regenerated noise and bypass paths are considered.

Component data may not add directly when test configurations, flow, frequency bands or source impedances differ. Field verification remains necessary.

29.21 Power, grounding, UPS, generators, and electromagnetic boundaries

Secure facilities require resilient power without creating uncontrolled conductive paths. Normal feeders, emergency feeders, uninterruptible power supplies, generators, bonding conductors, surge protection and monitoring circuits cross the boundary. Transformers, switch-mode converters and rotating equipment can generate audible and structure-borne noise. Grounding choices affect safety, electromagnetic compatibility and technical-security design. [129]

Electrical coordination should distinguish protective earthing, signal reference, bonding and shielding. The acoustical engineer should not prescribe an electromagnetic-security topology, while the electrical or EMSEC specialist should not assume that a conductive enclosure guarantees sound isolation. Penetrations, busways, cable trays and equipment supports require geometric details, firestopping, inspection and accessible future capacity.

Power-state commissioning should include normal utility, UPS transfer, generator operation, battery mode, maintenance bypass, low-load and alarm conditions. Each state can change background sound, fan operation, magnetic fields, control-system status and permissible use. Configuration records should identify firmware, set points, battery capacity, load, transfer behaviour and any operational restriction during degraded power.

Worked example 29.12. UPS autonomy screen

A UPS supports a 12 kW critical load from a nominal 96 kWh battery. The usable fraction is 0.80 and conversion efficiency is 0.91. Let t be idealised autonomy.

The energy screen gives 5.83 hours before reserve, ageing and temperature corrections. It supports operating-state planning and test scheduling.

129 MB-0801. International Electrotechnical Commission, IEC 60942:2017.

Actual runtime depends on discharge rate, battery age, temperature, inverter limits and non-critical loads. It does not authorise the facility to remain in use during a power event.

29.22 Telecommunications, classified systems, FRCS, and the cyber-authorisation boundary

Voice, video, data, access control, intrusion detection and facility-related control systems can connect the secure room to networks far beyond its physical boundary. A device may be acoustically quiet yet provide an electronic capture path. A control system may maintain pressure and masking while exposing remote maintenance functions. Physical commissioning and cyber authorisation therefore intersect but remain distinct decisions. [130]

System architecture should identify network zones, data flows, remote access, device identities, time sources, update mechanisms, logs, interfaces and fail states. Facility-related control-system cybersecurity should be designed with the applicable RMF process, but design compliance does not itself issue an authorisation to operate. Likewise, an ATO for an information system does not establish the acoustic performance of the room or its mounting details.

Integrated testing should exercise loss of network, controller restart, certificate expiry, failed sensor, manual override and maintenance modes. Evidence should preserve software and firmware versions, configuration exports, hashes, time synchronisation and responsible administrators. Changes to connected devices should trigger both cyber and physical review

130 MB-0237. ASTM International, ASTM E2638-24.

when they affect penetrations, source levels, supports, background sound or authorised communications.

Facility-related control systems require a joint physical and cyber configuration model; a controller can alter fan speed, door release, masking, lighting, alarms, or environmental state without changing the visible construction; remote support can create a maintenance pathway that bypasses ordinary room access controls. Firmware updates can change timing, fail-safe behaviour, logging, certificates, or network dependencies; the secure-facility baseline should therefore include device identity, hardware revision, firmware, configuration hash, network address, trust relationship, administrator role, backup, restore procedure, remote-access state, and approved operating logic. Cyber authorisation and facility accreditation remain distinct decisions, but their evidence should be reconciled where one system changes the physical security state. A complete commissioning record should demonstrate not only that the system functions, but that it fails, recovers, logs, and re-enters service in the authorised manner under loss of network, power, time source, sensor, or supervisory control.

Worked example 29.13. Critical-path availability

A protected environmental function depends on four series components with observed availabilities 0.999, 0.995, 0.998 and 0.997. Let A_s be the series availability under an independence approximation.

The combined availability is about 98.91 per cent, materially lower than any single component. Redundancy or operational restrictions may be justified.

Failures may be correlated through common power, network, software or maintenance. The independence model can overstate actual resilience.

29.23 Fire protection, life safety, accessibility, and security conflict resolution

Security requirements cannot suspend fire protection, safe egress or accessibility law. Rated walls, smoke barriers, sprinkler piping, fire alarm devices, emergency communications, door hardware and accessible routes intersect the secure boundary. The engineering task is coordinated compliance, not choosing one discipline after construction makes the conflict visible. [131]

Door assemblies illustrate the problem. Acoustic seals require controlled compression. Fire listings restrict substitutions. Egress hardware must release appropriately. Access-control components require fail-safe or fail-secure behaviour according to the approved design. Automatic operators and clear opening requirements alter geometry and loads. A change that improves one function can invalidate testing or listing in another.

The coordinated matrix should identify code basis, listing, security requirement, accessibility criterion, operating mode, test method, authority and approved configuration. Mock-ups are valuable where multiple requirements converge. Emergency and fire-alarm states should be included in functional testing and operating restrictions. A secure room that cannot be safely evacuated, maintained or used by authorised persons is not a successful facility.

131 MB-0871. International Organization for Standardization, ISO 16283-1:2014.

Worked example 29.14. Door-cycle demand

A door is expected to operate 140 cycles per working day for 250 days per year. Let N_y be the annual cycle demand and N_5 the five-year demand.

The five-year demand is 175,000 cycles. Hardware selection, preventive maintenance and recommissioning intervals should reflect that service level.

Cycle count does not represent impact, abuse, environmental exposure or emergency operation. Manufacturer and listing limitations remain controlling.

29.24 TEMPEST, EMSEC, TSCM, and acoustic non-equivalence

Acoustic isolation, compromising emanations protection and technical-surveillance countermeasures address different physical mechanisms. Sound propagates through air and structure. Electromagnetic emanations couple through radiation and conductors. Optical, ultrasonic, radio-frequency and electronic capture paths require their own models and authorities. A favourable result in one domain cannot be credited automatically in another. [132]

The integrated design should identify boundaries without merging criteria. Metal layers can influence electromagnetic behaviour while introducing structural bridges. Shielded penetrations can remain acoustically weak. A sound-masking system can reduce speech intelligibility while adding electronics, cabling and remote-control interfaces. Technical-security reviews should therefore exchange interface information without disclosing or inventing protected thresholds.

132 MB-0246. ASTM International, ASTM E2964-26.

Reports should state the discipline, method, configuration and proposition for every result. Terms such as secure, shielded and protected should be qualified. When a change affects several domains, the work-control package should route the change to each responsible authority. The strongest claim supported by public evidence is an integrated process claim, not a declaration that acoustic construction defeats every collection mechanism.

Technical-security coordination should begin before architecture fixes the accessible spaces and service routes; the architectural team needs to know which interfaces require specialist review without receiving protected criteria that it is not authorised to hold; this can be achieved through controlled requirement identifiers, interface envelopes, hold points, and pass-or-disposition records. The general designer may be told that a route requires approved treatment and inspection while the specialist retains the detailed rationale; the record should preserve that division without creating unexplained gaps; acoustic testing should similarly avoid claiming coverage of electromagnetic, optical, electronic, cyber, or active technical threats. Where several disciplines examine the same penetration or device, their observations should be correlated but their conclusions kept separate; a passed acoustic test does not validate technical-security controls; a technical inspection does not establish field sound isolation; the authority package should show which discipline evaluated which mechanism, under what configuration, and with what residual limitation.

Worked example 29.15. Weakest-domain index

Four independently scored assurance domains have bounded evidence values of 0.94, 0.88, 0.91 and 0.83. Let I_w be the weakest-domain index used for project screening.

The integrated screen is controlled by the 0.83 domain. Improving already stronger domains does not change the weakest-domain result.

The scores are project-defined and may not be probabilistically independent or commensurate. They do not represent governmental accreditation criteria.

29.25 Construction Security Plans and threat-informed execution

The Construction Security Plan converts authority and threat assumptions into field controls. It should identify protected areas, personnel screening, material handling, surveillance, escorts, storage, tools, communications, photography, waste, incidents, stop-work powers and evidence. The plan must be available before the project begins, not reconstructed after critical work is concealed. [133]

Threat-informed execution does not mean publishing the threat. The field team needs actionable controls, responsibilities and prohibited conditions. Sensitive rationales can remain in a protected annex. The unclassified construction package can still define who may enter, what may be photographed, how materials are inspected, how deviations are reported and which work requires direct observation.

The plan should evolve through approved change, not informal practice. Staffing, shifts, subcontractors, logistics and schedule acceleration can alter exposure. Daily reports should reconcile personnel, work areas, materials, inspections, incidents and open conditions. Completion of construction does

133 MB-0286. ASTM International, ASTM E413-22.

not close the plan until records, discrepancies, materials, tools, temporary systems and protected information are accounted for and transferred.

Worked example 29.16. Surveillance staffing demand

Three simultaneous work zones require two observers each, while one additional observer covers relief and records. Two shifts operate daily. Let N_d be the observer-shifts required per day.

The programme requires fourteen observer-shifts per day before supervisory, leave and contingency factors are applied.

The arithmetic assumes all zones operate simultaneously and each observer can cover only one assigned function. The competent security authority determines actual staffing.

29.26 Inspectable materials, supply chain, and material identity

Material control begins before delivery. Products, assemblies and embedded electronics should be traceable to approved submittals, manufacturers, models, lots, serials and authorised substitutions. Inspectable-material rules, supply-chain review and custody controls reduce uncertainty about what enters the protected boundary. They do not replace technical performance testing. [134]

The receiving process should verify packaging, seals, damage, documentation, storage, custody and disposition of anomalies. Concealed components deserve particular attention because later inspection is difficult. Electronic devices require firmware, software bill of materials where applicable, network capability, update route and remote-service review.

134 MB-0913. International Organization for Standardization, ISO/IEC 17025:2017.

Construction materials require dimensional, fire, structural and acoustic identity.

A material register should link purchase order, submittal, delivery, inspection, installation location, photograph, test certificate and as-built record. Unidentified surplus and removed components should be controlled. A substitute can be technically reasonable yet unacceptable if it lacks authority review or breaks configuration evidence. Material identity is therefore both an engineering and security record.

Worked example 29.17. Chain-of-custody completeness

A lot contains 120 controlled components. One hundred fourteen have complete receipt, inspection, storage and installation records. Four have receipt and installation records only, and two are unaccounted for. Let C_c be complete custody coverage.

Complete custody coverage is 95.0 per cent, but the two unaccounted components are controlling exceptions requiring immediate reconciliation.

A high percentage cannot neutralise missing high-consequence items. The count does not establish authenticity or functional performance.

29.27 Construction surveillance, SSM and CST functions, escorts, and concealed work

Construction surveillance protects the evidentiary interval before work disappears behind finishes. The Site Security Manager, construction-surveillance technicians, escorts, quality personnel and design representatives perform different functions. The surveillance record should show who observed what, under which authority, at what stage and with what limitations. [135]

135 MB-0338. ASTM International, ASTM E90-23.

Concealed-work controls should be tied to the construction sequence. Wall cavities, joints, frames, sleeves, duct transitions, floor interfaces, ceiling closures and embedded systems require release before covering. Observation should include dimensions, materials, fasteners, seals, supports, routing and photographs where permitted. A signature without defined scope is weak evidence.

Missed surveillance is a nonconformance, not a clerical omission; recovery may require targeted opening, alternative examination, testing, authority disposition or removal and reconstruction; escorts should not be assigned technical verification they are not qualified to perform; conversely, technical inspectors must comply with security controls and access limitations. Effective surveillance is a coordinated evidence system, not a single job title.

A missed concealed-work hold point is an evidentiary failure even when the installation may be physically correct; the recovery plan should be proportionate to consequence and uncertainty; options include document reconciliation, witness interviews, material traceability, non-destructive inspection, borescope examination, local opening, destructive sampling, targeted functional testing, or complete reconstruction. The decision should consider whether the omitted observation concerned identity, geometry, workmanship, continuity, concealed routing, or a protected feature; a photograph taken after closure cannot prove an invisible condition merely because the exterior appears orderly. Conversely, indiscriminate demolition may damage a compliant assembly and create new risks. The responsible authority should approve the recovery method and the acceptance boundary. The nonconformance record should preserve why the original hold point was missed, what alternative evidence was obtained, what uncertainty remains, and which process change prevents recurrence on later work.

Table 29-7. Construction-security and concealed-work hold points.

Work item	Observe before	Minimum record	Missed-point recovery
Wall cavity	Final closure	Materials, fasteners, seals, route photograph	Authorised opening or equivalent evidence
Door frame	Grouting and finish closure	Anchors, plumb, perimeter treatment	Local opening, measurement and disposition
Penetration	Firestop concealment	Sleeve, fill, backing, seal depth	Re-open or reconstruct
Duct transition	Ceiling closure	Geometry, silencer, damper and access	Borescope, opening or targeted test
Embedded system	Finish installation	Model, serial, route, firmware	Inventory reconciliation and inspection

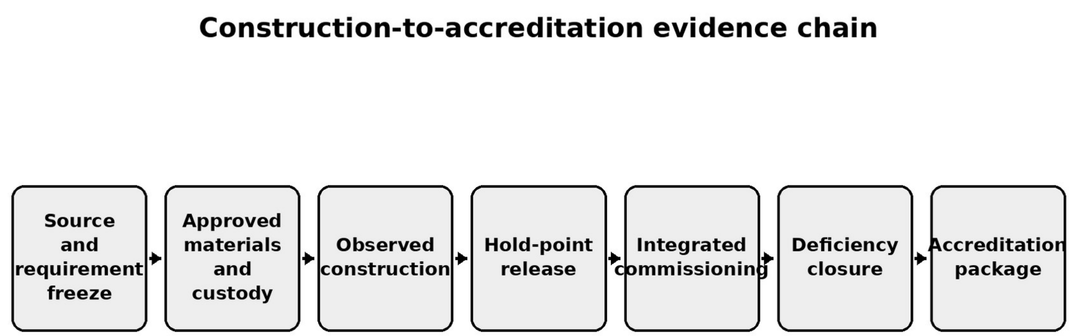

Figure 29-4. Construction evidence moves through source control, material identity, surveillance, hold-point release, commissioning and deficiency closure before it can support accreditation. Author original diagram.

Worked example 29.18. Hold-point release coverage

A construction package defines 96 mandatory hold points. Ninety were witnessed and released, four were recovered by authorised opening, and two remain unresolved. Let C_h be closed hold-point coverage.

Closed coverage is 97.92 per cent, with two unresolved hold points that must remain visible to the accepting authority.

Hold points differ in consequence. The calculation does not authorise concealment or acceptance of the two remaining items.

29.28 First-of-type mock-ups, hold points, and acceptance sampling

First-of-type work converts drawings into observable construction before repetition magnifies an error. A representative wall, door, penetration, duct transition or modular interface can reveal tolerance conflicts, inaccessible fasteners, incompatible sealants, listing limitations and impractical inspection steps. The accepted first article should become a controlled reference, not an informal demonstration. [136]

Sampling is appropriate only after process stability and consequence are considered. Repetitive low-risk work may support statistical inspection. Unique or concealed high-consequence interfaces may require full observation; the sampling plan should identify population, unit, selection method, acceptance rule, escalation, lot separation and treatment of repaired items. Convenience samples selected by the installer provide weak evidence.

When a sample fails, the response should address cause and population extent; merely repairing the observed unit can leave systematic defects elsewhere; expanded sampling, process correction, reinspection and authority disposition may be required. Records should preserve the

136 MB-0814. International Organization for Standardization, ISO 10140-1:2021.

selection basis and rejected units so that later reviewers can reproduce the inference rather than seeing only the final pass count.

Worked example 29.19. Zero-failure sampling screen

A stable lot contains 200 similar low-consequence installations. Thirty are sampled randomly and no defects are observed. Using the simple rule of three, let p_u be the approximate 95 per cent upper bound on defect proportion.

Even with zero observed defects, the simple upper bound is about 10 per cent. A larger sample or full inspection may be required where that residual possibility is unacceptable.

The rule of three is an approximation for independent Bernoulli trials and zero observed events. It is inappropriate for clustered workmanship or high-consequence unique conditions.

29.29 Security-minded information management, BIM, and tiered record release

Secure-facility records must be useful without creating unnecessary disclosure. Models, drawings, photographs, penetration registers, equipment inventories and test results vary in sensitivity. A security-minded information plan should define data tiers, approved repositories, access, transfer, redaction, retention, backups, destruction and release authority. [137]

Building information modelling can improve coordination and lifecycle maintenance, but a complete federated model can reveal route topology, room functions and security systems. The solution is not to abandon structured information. It is to separate operationally necessary views,

137 MB-0816. International Organization for Standardization, ISO 10140-2:2021.

protect high-consequence layers, control exports and preserve provenance. Redaction should remove content rather than merely conceal display layers.

Each record should carry owner, classification or control marking, revision, hash or integrity control, access list and disposition. Field photographs require location and scope while avoiding uncontrolled metadata or devices. Contractors should know which deliverables may remain in ordinary project systems and which must move to authorised repositories. The final handover should reconcile duplicates and confirm that temporary working copies have been disposed of properly.

Worked example 29.20. Least-access screening

A record package has 1,200 items. Operational staff require 420, maintenance staff require 610, and security staff require all 1,200. After tiering, 170 items formerly shared broadly are restricted. Let R_b be the broad-access reduction.

Tiering reduces broad exposure by 14.17 per cent while retaining access for authorised roles.

The percentage does not prove that access assignments are correct. Content sensitivity, aggregation and mission need require human review.

29.30 Commissioning architecture and functional performance testing

Commissioning should verify the integrated facility against the authorised basis, not merely collect trade start-up sheets. The plan should identify systems, states, prerequisites, witnesses, instruments, tolerances, data, deficiencies and authority interfaces. Security, acoustics, HVAC, electrical power, controls, communications, doors, fire and life safety should be exercised as a coordinated system. [138]

Functional tests should include normal, degraded, emergency and maintenance states that are credible for the mission. A masking system may meet its spectrum during normal power but fail silently on network loss. A door may seal when adjusted for testing but bind under pressure or automatic operation. A fan sequence may create a quiet night condition that was never included in the privacy assessment.

The commissioning record should link each test to the as-built configuration and open conditions. Adjustments made during testing must be recorded. Retests should identify whether the original defect, collateral effects and affected population were examined. Completion percentages are useful for management, but controlling prerequisites and authority dispositions determine readiness.

Commissioning should use a state matrix derived from mission use rather than a generic equipment start-up list; for each test, the plan should identify source activity, occupancy, doors, access panels, HVAC mode, masking state, communications state, emergency overrides, background conditions, neighbouring access, and instrument configuration. The same room can produce materially different results across these states; a daytime test with high plant noise may conceal a quiet-hour leakage path; a door tested only after manual adjustment may not represent normal automatic closing; a communications system tested without its ceiling microphone array may omit a structural excitation source. The matrix should include expected

138 MB-0817. International Organization for Standardization, ISO 10140-4:2021.

result, measurement uncertainty, decision rule, witness, raw-data location, and restoration check; failed or conditional states should be linked to restrictions on use; this prevents a favourable broadband average or a single convenient operating state from being treated as proof of the complete accredited configuration.

Table 29-8. Commissioning and functional-test matrix.

State	Systems exercised	Primary measurands	Decision record
Normal occupied	Doors, HVAC, masking, communications	Levels, pressure, functionality	Baseline acceptance
Quiet or night	Reduced plant and occupancy	Background and speech margin	Use restriction or mitigation
Emergency	Alarm, egress, smoke and power transfer	Safe function and security effect	Emergency operating condition
Maintenance	Bypass, access panels, remote support	Temporary exposure and restoration	Work authorisation and closure
Degraded or failed	Network, sensor, fan or masking failure	Detection, alarm and safe state	Incident response and restriction

Worked example 29.21. Weighted commissioning completion

A commissioning plan has 50 ordinary tests weighted 1, eight major tests weighted 3 and two authority gates weighted 10. All ordinary tests, six major tests and one authority gate are complete. Let C_w be weighted completion.

Weighted completion is 82.98 per cent, although 57 of 60 line items are closed. The open authority gate remains decisive.

Weights are project management values, not accreditation criteria. A completed test can still be technically deficient or inapplicable.

29.31 Field sound-isolation testing, local leakage, and speech-security assessment

Field acoustic work should begin with a bounded question. Room-to-room level difference, apparent transmission loss, local sound intensity, vibration response and speech-privacy assessment are different measurands. The selected method should match the source, rooms, listener access, background and decision rule. No single number captures every path or occupied condition. [139]

The test plan should preserve source spectrum, level, directivity, positions, room states, HVAC, masking, doors, equipment, background, calibration and uncertainty. Local scanning can identify dominant leakage after a whole-room result, but diagnostic temporary seals must be separated from acceptance testing. Listener positions should follow access analysis rather than convenient grid symmetry.

Speech-security conclusions require caution. Audibility and intelligibility vary with language, hearing, repetition, context and receiving background. A technically competent field result does not issue accreditation. The report should state the measured quantity, conditions, detection limits and strongest supported inference, then submit that evidence to the authorised decision process.

Field acoustic measurements should be designed to diagnose paths as well as calculate ratings; room-average level differences can establish a defined field quantity, but local scans, source relocation, temporary seals, door operation, plant-state changes, vibration measurements, and controlled interventions help identify the governing mechanism. Diagnostic changes should be reversible and documented; an improvement after temporary sealing supports a path hypothesis, but it does not prove that the permanent repair will deliver the same result; conversely, a small change may indicate that several parallel paths remain. The test record should preserve spectra, time histories, source stability, backgrounds, positions,

139 MB-0818. International Organization for Standardization, ISO 10140-5:2021.

photographs, calibration, environmental conditions, and every intervention. Conclusions should identify what was measured, what was inferred, and which credible states were not tested. The authority can then decide whether the evidence supports acceptance, remediation, restriction, supplemental examination, or a broader technical-security review.

Worked example 29.22. Guarded field result

A measured field level difference is D = 52.4 dB with expanded uncertainty U = 1.7 dB. The agreed rule requires D - U to equal or exceed a 50 dB project threshold. Let D_g be the guarded result.

The guarded result is 50.7 dB and meets the stated numerical rule by 0.7 dB.

The uncertainty budget covers only represented contributors. Untested states, configuration uncertainty and authority conditions remain separate.

29.32 Measurement uncertainty, guard bands, and decision rules

Measurement uncertainty is part of the result, not an appendix decoration. Instrument calibration, source stability, spatial sampling, background correction, room decay, environmental conditions, repeatability and processing each contribute. Some components are correlated and should not be combined as though independent. The model should match the reported measurand. [140]

Decision rules should be agreed before testing. A simple observed-value comparison can produce different outcomes from a guarded rule. The report should identify the coverage factor, expanded uncertainty, treatment of covariance and whether risk is allocated to the provider, consumer or

140 MB-0900. International Organization for Standardization, ISO 717-1:2020.

shared through an indeterminate zone. Guard bands should not be invented after an inconvenient result.

Uncertainty does not excuse poor method or incomplete configuration evidence. It quantifies recognised dispersion within the model. A small numerical uncertainty can coexist with a large unmodelled configuration risk. The authority should receive both the metrological statement and the operational limitations needed to judge the facility.

Worked example 29.23. Root-sum-square uncertainty

Four independent standard uncertainty components are 0.55, 0.70, 0.35 and 0.60 dB. Let u_c be combined standard uncertainty and U the expanded uncertainty for coverage factor k = 2.

The expanded uncertainty is 2.26 dB under the stated independence and coverage assumptions.

Correlated inputs require covariance terms. The result does not include untested operating states or unknown construction deviations.

29.33 Accreditation packages, conditions, deficiencies, and open items

An accreditation package is a controlled body of evidence supporting a governmental decision. It may include authority documents, design approvals, construction-security records, as-builts, inventories, test reports, technical reviews, waivers, deficiencies, operating procedures and residual-risk dispositions. The package should represent the actual configured facility, not a mixture of design intent and unverified closeout promises. [141]

141 MB-0278. ASTM International, ASTM E336-25a.

Open items require consequence-based treatment. Some prevent use. Others support a conditional approval, temporary restriction or scheduled corrective action. The record should identify owner, due date, interim control, verification method and authority. Closing an item administratively without demonstrating the repaired condition creates a false baseline that later reciprocity and inspection decisions may inherit.

Package quality is improved by a traceability index linking each requirement to design, installation evidence, test and disposition. Superseded versions should remain accessible but clearly marked. The final decision letter should define authorised use, conditions, review triggers and any areas excluded. Accreditation is an official risk decision, not a percentage score or a consultant's certificate.

Table 29-9. Accreditation and reciprocity evidence matrix.

Evidence class	Accreditation purpose	Reciprocity question	Material-change trigger
Authority documents	Defines applicable framework	Is the original authority acceptable?	Authority or mission change
As-built configuration	Identifies physical baseline	Does current state match?	Boundary, service or equipment change
Technical tests	Supports bounded performance claims	Are methods and states relevant?	Drift, new use or altered source
Conditions and waivers	Defines residual limits	Do conditions transfer?	Expiry or mitigation change
Operations records	Shows continuing control	Is baseline still sustained?	Incident, inspection or maintenance finding

Worked example 29.24. Weighted open-item closure

An accreditation package has 12 low-weight items valued 1, five medium items valued 3 and two controlling items valued 10. All low items, four medium items and one controlling item are closed. Let C_o be weighted closure.

Weighted closure is 72.34 per cent. The remaining controlling item prevents a readiness conclusion despite 17 of 19 items being closed.

The weights are illustrative. Only the responsible authority can determine the effect of a deficiency or condition on authorised use.

29.34 Reciprocity, co-use, joint-use, and configuration equivalence

Reciprocity allows an authorised organisation to rely upon an existing accreditation under defined conditions. It is not automatic recognition of a room label. The relying organisation should confirm the authority, current configuration, authorised function, information domains, users, technical systems, conditions and material changes relevant to the proposed use. [142]

Co-use and joint-use arrangements add governance and physical complexity. Organisations may share the facility while retaining separate responsibilities, systems or compartments. Changes in occupancy, equipment, network connection, access or operating hours can affect both security and acoustic source states. Agreements should define ownership, incident reporting, maintenance, change review and termination.

Configuration equivalence should be affirmative. A relocated modular room, replaced door, altered return-air route or new conference system can invalidate a previous comparison. The reciprocity package should identify what was reviewed, what was excluded and which conditions remain. A copied accreditation date without configuration evidence is not a sound basis for reliance.

142 MB-0871. International Organization for Standardization, ISO 16283-1:2014.

Worked example 29.25. Reciprocity-equivalence score

A reciprocity review compares 25 controlling configuration attributes. Twenty-two match, two have approved mitigations and one is unresolved. Let C_e count matches and approved mitigations as equivalent for project screening.

The screening equivalence is 96 per cent, but the single unresolved attribute remains an explicit authority decision.

Attributes are not equally consequential. The calculation cannot grant reciprocity or determine whether the approved mitigations apply to the new use.

29.35 Special Access Program Facilities and additional control layers

A Special Access Program Facility may share many physical mechanisms with a SCIF, yet SAP policy, sponsorship, access, information handling and approval are separately governed. Public DoD policy and the 2025 SAP security manual should be treated as an authority framework. Programme-specific details can be controlled and must not be inferred from general SCIF criteria. [143]

Design teams should identify whether a space is SCI, SAP, dual-use or subject to another controlled programme. The label affects authority, records, construction security, communications, personnel and lifecycle. Where one enclosure supports several regimes, the project should reconcile the most demanding applicable interfaces without assuming that compliance with one programme satisfies another.

143 MB-0816. International Organization for Standardization, ISO 10140-2:2021.

Additional control layers can increase resilience, but they also increase configuration complexity. Separate access systems, communications, alarm paths and records can create new penetrations and maintenance activities. Integration should preserve clear ownership and testable states. Public documentation should explain the process and boundaries without revealing protected programme implementation.

Reciprocity should be supported by an evidence crosswalk rather than by copying the originating approval letter into a new file; the receiving authority needs to understand mission, facility boundary, authorised information, construction baseline, technical systems, waivers, conditions, inspection history, incidents, and changes since the original decision. Some evidence may be transferable; other evidence may depend on local threat, adjoining access, communications, or agency-specific policy; the crosswalk should identify exact equivalence, bounded equivalence, non-equivalence, and information that cannot be publicly or administratively shared. Conditions should remain visible. A facility approved for one use, one sponsor, or one system state should not silently expand through repeated reciprocity assumptions; the receiving decision should record the evidence reviewed and the limits accepted. This preserves efficiency without converting reciprocity into an assertion that all agencies use identical criteria or that an earlier approval survives every later change.

Worked example 29.26. Layered residual screen

Three sequential safeguards are estimated for planning to reduce a bounded event likelihood by factors 0.30, 0.25 and 0.40. Let r be the residual factor under an independence approximation.

The illustrative residual factor is 0.03, or three per cent of the starting value.

Safeguards can share common causes and are not generally independent. The factors are not governmental probabilities and should not be used as accreditation criteria.

29.36 Cleared contractor facilities, industrial security, and the NISPOM rule

Cleared industry operates within the National Industrial Security Program and 32 CFR Part 117. Facility clearance, classified contracts, safeguarding, self-inspection, intrusion detection, information systems and cognizant security oversight form an industrial-security framework distinct from SCIF accreditation. Some contractor spaces also require SCI or SAP approval under the applicable authority. [144]

The contractor's senior management official, Facility Security Officer, government contracting activity and cognizant security agency have defined responsibilities. The engineering team should know which requirement arises from the NISPOM rule, a contract security classification specification, an SCI or SAP authority, a local code or a project decision. Conflating them creates gaps and unsupported claims.

Self-inspection and government review should include physical configuration, classified operations, access, alarms, records, incidents and corrective actions. Construction and maintenance affecting a secure boundary should be routed through the FSO and the appropriate government authority. A commercial product or laboratory report can

144 MB-0852. International Organization for Standardization, ISO 12999-1:2020.

support compliance evidence, but it does not establish facility clearance, SCI accreditation or programme approval.

Table 29-10. Agency and programme crosswalk.

Framework	Primary public authority	Facility relationship	Non-equivalence warning
Intelligence Community	ICD 705, ICS 705 series	SCIF policy, standards and accreditation	Public documents do not disclose all criteria
Department of Defense	DoDI and DoDM families, UFC 4-010-05	SCI, SAP and facility delivery	UFC does not itself accredit
Cleared industry	32 CFR Part 117 and DCSA oversight	NISP safeguarding and contractor governance	Facility clearance is not SCIF accreditation
DOE/NNSA	DOE safeguards and security directives	Nuclear, SCI and technical-security contexts	DOE programme authority remains separate
GSA and ISC	Core building standards and ISC risk process	Civilian federal host facility	Base-building security is not SCI approval

Worked example 29.27. Self-inspection closure rate

A cleared facility self-inspection identifies 28 findings. Twenty-four are verified closed, two have interim controls and two remain open without approved disposition. Let C_i be verified closure.

Verified closure is 85.71 per cent. Interim controls and unresolved findings should remain visible to management and government oversight.

The count does not weight finding severity and does not determine the facility's security rating or clearance status.

29.37 DOE and NNSA safeguards and security comparison

The Department of Energy maintains its own safeguards and security directives for programme operations, planning, technical security, information security and physical protection. DOE and NNSA facilities can also handle SCI and operate SCIFs, but the Departmental framework includes nuclear, material, protective-force and restricted-data concerns that are not reducible to ordinary SCIF doctrine. [145]

Crosswalks should compare functions rather than assume equivalence of names. DOE O 470.4C addresses safeguards and security planning. DOE O 470.6 governs the Technical Security Program. DOE O 471.6 addresses information security, and DOE O 473.1A addresses physical protection. The applicable contract, site plan and authority determine how those directives interact with SCI requirements.

Acoustic engineering contributes through protected-conversation analysis, boundary design, field measurement and change control. It does not evaluate nuclear-material protection or issue DOE authority. A multi-agency facility should maintain separate requirement keys and a conflict-resolution record. Public DOE sources can explain the institutional framework while controlled site criteria and threat information remain protected.

Worked example 29.28. Crosswalk coverage

A DOE-SCI crosswalk contains 36 functional topics. Thirty-one have mapped authorities, evidence and conflict dispositions. Five remain unmapped. Let C_x be crosswalk coverage.

The crosswalk is 86.11 per cent complete. The five unmapped functions should not be treated as equivalent by silence.

Mapping coverage does not establish legal equivalence or compliance. Each authority retains control over its programme.

145 MB-0891. International Organization for Standardization, ISO 3382-2:2008.

29.38 GSA, ISC, and civilian federal-facility interfaces

Civilian federal facilities may involve GSA as owner or leasing authority, the Interagency Security Committee risk-management process, a tenant agency security organisation and the Federal Protective Service. A SCIF within such a building adds an Intelligence Community authority without displacing base-building law, leases, fire protection, accessibility or facility-security governance. [146]

Early coordination should define landlord and tenant responsibilities, base-building information, service access, security countermeasures, construction approvals, outages, after-hours work and restoration. Shared buildings create listener-access, utility and maintenance conditions that differ from controlled campuses. Lease boundaries can limit destructive investigation and influence where resilient rooms or modular systems are feasible.

The project should maintain a jurisdiction and responsibility matrix. GSA standards, ISC countermeasures, tenant criteria and SCIF requirements should be coordinated at interfaces rather than averaged into one generic federal standard. Later facility-security decisions or landlord work can affect the secure room, so notification and event-driven review should be written into operating agreements.

Civilian federal facilities frequently contain several governance layers. The building owner may control structure, utilities, life safety, and common areas; a tenant agency may control mission spaces; the Federal Protective Service or another security organisation may manage facility security; an information owner may control classified or sensitive use; and a specialised

146 MB-0246. ASTM International, ASTM E2964-26.

authority may govern a compartmented area. The project should map these layers before design; a countermeasure accepted at building level may be insufficient for a tenant mission, while a tenant modification may conflict with lease, fire, accessibility, or building-system obligations; the integrated risk register should therefore trace each countermeasure to its decision owner, funding source, installation authority, maintenance party, and re-evaluation trigger. It should also identify shared dependencies, such as emergency power, central controls, loading docks, roofs, risers, and neighbouring tenants; this prevents a secure-room project from treating the host building as a neutral shell when the host systems materially shape both exposure and lifecycle reliability.

Worked example 29.29. Countermeasure implementation rate

A facility committee approves 18 countermeasures. Fifteen are implemented, two are funded and scheduled, and one is awaiting an authority decision. Let C_f be implemented fraction.

The implemented fraction is 83.33 per cent. Scheduled and unresolved measures remain open conditions rather than completed security.

The count does not represent risk reduction, facility security level or SCIF accreditation.

29.39 Operations baseline, access, inspections, and daily security discipline

Accreditation is sustained through daily operation. The baseline should identify boundaries, doors, alarms, communications, technical systems, masking, HVAC, access rules, emergency states, approved equipment and responsible custodians. Users should understand which conditions are essential and how to report a fault without attempting unauthorised repair. [147]

Routine inspections should focus on dynamic and accessible elements. Door seals, latches, ceiling tiles, penetrations, equipment inventories, masking status, alarms, service panels and adjoining access can change quickly. Inspection intervals should reflect use, wear, consequence and observed failure history. Checklists are valuable only when inspectors are trained to recognise mechanisms and record exceptions.

Operational discipline includes door control, visitor management, equipment restrictions, cleaning, maintenance access, quiet-hour use and incident reporting. A room can pass commissioning and then become vulnerable through propped doors, disabled masking or undocumented equipment. The inspection record should support trend analysis and trigger technical review when repeated small defects indicate configuration drift.

Worked example 29.30. Inspection-frequency demand

A dynamic doorset is inspected every 30 days, a masking system every 90 days and a concealed-boundary survey every 365 days. Over two years, let N_i be the nominal total inspection events, excluding coincident scheduling.

Approximately 34 inspection events are scheduled over two years. A consolidated visit can reduce administrative burden while preserving each required scope.

Calendar division is a planning estimate. Event-driven inspections, downtime and authority-specific intervals can change the actual programme.

147 MB-0286. ASTM International, ASTM E413-22.

29.40 Maintenance, SRM, minor construction, and controlled work authorisation

Sustainment, restoration and modernisation work can alter a secure boundary more often than capital projects. A cable addition, door repair, ceiling access, sprinkler modification or software upgrade may appear minor to facilities staff while changing a security or acoustic path. Work control should screen scope before tools enter the space. [148]

The authorisation process should identify affected systems, drawings, access, escorts, outages, temporary conditions, inspection, testing, restoration and authority review. Like-for-like replacement requires demonstrated equivalence. Emergency repairs require immediate risk control and prompt retrospective reconciliation. Deferred maintenance should be visible because accumulating small defects can create a material change.

Maintenance records should link asset, fault, parts, personnel, photographs, measurements and closure. Removed components and temporary penetrations require accountability. Recommissioning should be proportional to the mechanism affected, not automatically full or automatically waived. The objective is to preserve the authorised baseline while permitting necessary facility care.

Maintenance governance should classify work by potential effect rather than by contract value or apparent simplicity; replacing a door closer, balancing a diffuser, adding a cable, updating a controller, repainting a seal interface, or moving a ceiling device may be financially minor yet technically consequential. The maintenance system should screen location, system,

148 MB-0213. ASTM International, ASTM E1414.

boundary crossing, configuration change, need for escort, concealed-work exposure, testing, documentation, and authority notification; repetitive work deserves standard approved procedures, but those procedures should specify the exact eligible configuration and stop conditions. Work orders should capture before and after state, parts, personnel, photographs, settings, removed items, anomalies, and restoration checks; trend analysis can reveal recurring causes such as seal wear, cable growth, access-panel damage, filter-induced pressure shifts, or software drift. Maintenance then becomes a source of assurance evidence rather than a sequence of undocumented exceptions to the original baseline.

Worked example 29.31. Maintenance-backlog exposure

A maintenance register has 40 open tasks. Eight high-consequence tasks carry weight 5, twelve medium tasks weight 2 and twenty low tasks weight 1. Four high, seven medium and ten low tasks are overdue. Let B_w be weighted overdue fraction.

The weighted overdue fraction is 52.38 per cent, indicating that backlog consequence is materially greater than a simple task count might suggest.

The weights are project-defined. Technical review must confirm whether any overdue task restricts authorised use.

29.41 Configuration change, software and firmware updates, and connected-system drift

Modern secure facilities contain software-defined systems. Access control, alarms, audiovisual devices, masking, HVAC controls, power monitoring and diagnostic platforms can change through firmware, configuration or cloud-service updates without visible construction. The configuration baseline should therefore include digital state as well as physical drawings. [149]

Change review should identify supplier, version, security advisory, signatures, dependencies, rollback, test environment, remote access and effect on operating states. A firmware update can alter fan speed, gain, network traffic, logging or failure behaviour. Replacement hardware can move a microphone, change loudspeaker output or add wireless functions. Physical and cyber reviewers need a shared trigger process.

Post-change testing should verify affected functions and preserve hashes or signed exports where practicable. Unplanned automatic updates should be disabled or governed according to the authorised architecture. Drift detection can compare current inventory and configuration against the golden baseline. A cyber approval alone does not establish unchanged acoustical performance, and an acoustic retest does not authorise the software.

Worked example 29.32. Configuration-drift index

A baseline contains 250 controlled attributes. A comparison finds 238 exact matches, seven approved differences and five unexplained differences. Let D_c be the unexplained drift proportion.

Unexplained drift is 2.0 per cent. The five attributes require investigation even though 98 per cent of the baseline is matched or approved.

Attributes differ in consequence. One unexplained network or boundary change can be more important than many benign matches.

149 MB-0913. International Organization for Standardization, ISO/IEC 17025:2017.

29.42 Periodic inspection, recommissioning, and material-change thresholds

Periodic assurance should be risk-based and event-driven. Calendar inspection detects gradual wear, while recommissioning tests whether a consequential state still performs. Material change can include altered boundary, services, equipment, software, occupancy, adjoining access, mission or authority. The threshold should be defined before a dispute arises. [150]

A trigger matrix should connect change type to required review. Door hardware replacement may require alignment and local leakage checks. New penetrations may require inspection, firestop verification and whole-room measurement. HVAC rebalance may require background, pressure and cross-talk testing. Major reconfiguration can reopen accreditation or reciprocity review.

Trend data strengthen decisions. Repeated measurements should use stable methods, positions and states so drift is distinguishable from method variation. A statistically significant change is not automatically a security failure, and a non-significant change can still be consequential if the acceptance margin is small. The authority receives the trend, uncertainty, configuration and recommended disposition.

Table 29-11. Lifecycle change and recommissioning triggers.

Change	Likely affected proposition	Minimum review	Possible escalation
Door or seal replacement	Local and whole-boundary performance	Alignment, seal and local test	Whole-room retest and authority review
New penetration	Air, structure, fire and route control	Inspection and register update	Targeted or whole-room retest

150 MB-0871. International Organization for Standardization, ISO 16283-1:2014.

Change	Likely affected proposition	Minimum review	Possible escalation
HVAC rebalance	Background, pressure and cross-talk	Functional and acoustic checks	Use-state restriction
Firmware or controller update	Operating state, logs and failure mode	Configuration and functional test	Cyber and physical authority review
Mission or adjoining-access change	Source and listener assumptions	Threat and use reassessment	Reaccreditation or new reciprocity review

Worked example 29.33. Recommissioning-trigger score

A project uses four screening factors: boundary change 4, system-state change 3, adjoining-access change 2 and measurement drift 3. The trigger threshold is 8. A proposed alteration scores 4 + 3 + 0 + 2.

The score of 9 exceeds the project threshold and routes the alteration to targeted recommissioning and authority review.

The score is a local workflow tool. It does not define material change for any governmental authority.

29.43 Incident response, evidence preservation, and cautious attribution

A security or acoustic incident may begin with audible speech, a failed masking zone, an unauthorised device, a displaced ceiling tile, a new cable or unexplained measurement degradation. Immediate action should protect information and people, secure the area, preserve configuration and notify responsible officials. Observation alone does not establish cause or exploitation. [151]

Evidence preservation should include logs, access records, system exports, photographs, measurements, removed components, witness accounts and environmental conditions. Time synchronisation and chain of custody matter. Investigators should maintain competing hypotheses, including

151 MB-0289. ASTM International, ASTM E477.

ordinary maintenance, workmanship, software change, user behaviour, environmental movement and malicious action.

Testing should progress from non-destructive whole-system checks to targeted local work and authorised opening. Reports should distinguish fact, measurement, interpretation, alternative causes, residual uncertainty and authority disposition. A vulnerability is not proof of compromise. Conversely, absence of proof does not justify restoring sensitive use before a responsible official has evaluated the condition.

Incident analysis should resist both premature exoneration and premature attribution; a sudden loss of field isolation may result from a damaged seal, an open access panel, a control-state change, a new penetration, structural movement, measurement error, or deliberate interference. Investigators should define competing hypotheses and identify observations that would discriminate among them; the examination sequence should preserve transient states before repair whenever safety and authority permit; logs, photographs, raw acoustic data, control exports, access records, work orders, removed components, witness accounts, and environmental measurements should be time-correlated. Investigative interventions must themselves be recorded because opening a wall or resetting a controller can erase evidence. The report should separate fact, measurement, analytical inference, excluded hypothesis, unresolved alternative, and residual risk. A vulnerability does not prove exploitation, while failure to prove exploitation does not automatically justify renewed sensitive use. Restoration and authorisation remain decisions for the responsible authority.

Worked example 29.34. Evidence-preservation completeness

An incident plan requires ten evidence classes. Eight are preserved completely, one is partial and one is unavailable. Assign complete = 1, partial = 0.5 and unavailable = 0. Let C_e be the screening completeness.

The evidence screen is 85 per cent complete. The unavailable class should be disclosed because it can limit causal attribution.

The scoring weights do not represent legal admissibility, evidentiary importance or classification rules.

29.44 Decommissioning, closure, sanitisation, and records disposition

A secure facility eventually closes, relocates or changes mission. Decommissioning should be planned with the same discipline as construction. Classified holdings, information systems, media, communications, access devices, alarms, technical-security components, temporary construction and protected records require authorised disposition. The physical enclosure may be removed, transferred or returned to ordinary use only after the controlling authorities close their obligations. [152]

The closure plan should identify inventory, sanitisation, destruction, removal, verification, restoration, waste, custody and documentation. Penetrations or modular systems can conceal components. Leased facilities require coordination with the owner while preventing disclosure. Reusable equipment should retain provenance and be re-evaluated before installation elsewhere rather than inheriting the former facility's approval.

152 MB-0906. International Organization for Standardization, ISO 7235.

Records disposition should preserve the minimum body needed for accountability, incidents, contracts and future claims while removing unnecessary exposure. Superseded drawings and test data remain sensitive even after the room closes. The final certificate should state what was inspected, removed, sanitised, transferred, destroyed or left in place, and identify any residual condition accepted by the responsible authority.

Worked example 29.35. Closure-inventory reconciliation

A closure inventory lists 480 controlled items. Four hundred sixty-eight are removed or destroyed with complete records, eight are transferred with approved custody, and four remain unresolved. Let C_d be disposition coverage.

Disposition coverage is 99.17 per cent, yet the four unresolved items prevent an unqualified closure statement.

Item counts do not weight sensitivity or confirm sanitisation quality. The responsible authority determines closure.

29.45 Integrated whole-of-government assurance and the public-release boundary

Chapter 29's central doctrine is that secure-facility assurance is an authority-governed lifecycle system. Public Intelligence Community, DoD, DCSA, DOE, GSA and ISC sources reveal overlapping functions, but they do not collapse into one universal secure-room code. Each programme retains its own authority, controlled criteria, risk decisions and vocabulary. [153]

The engineering contribution is substantial and bounded. It defines source states, maps paths, coordinates structures and services, controls

153 MB-0804. International Electrotechnical Commission, IEC 61672-1:2013.

construction, measures field performance, quantifies uncertainty, preserves evidence and supports lifecycle change. It does not grant accreditation, reciprocity, facility clearance, SAP approval, an information-system ATO or another agency's authorisation.

A publishable public framework should explain mechanisms and evidence without reconstructing protected thresholds. It should use exact source status, label inference, distinguish examples from official criteria and state what remains unknown. The strongest defensible release claim is that the chapter provides a rigorous public-source method for supporting competent-authority decisions across United States secure-facility contexts.

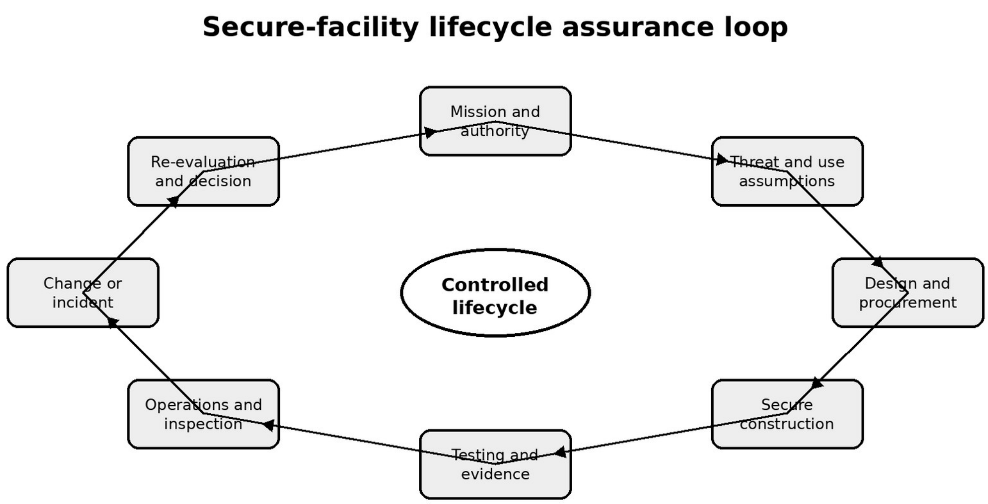

Figure 29-5. Whole-of-government secure-facility assurance is a lifecycle loop linking mission, authority, design, construction, testing, operations, change, incident response and renewed decision. Author original diagram.

Worked example 29.36. Integrated evidence coverage

An assurance package contains 72 required evidence links across authority, design, construction, testing, operations and change control. Sixty-eight are complete, three are conditional and one is missing. Count complete as 1 and conditional as 0.5. Let C_a be weighted coverage.

Weighted coverage is 96.53 per cent, but the missing link and three conditions remain explicit release limitations.

The calculation is a project-control screen. It cannot substitute for accreditation or another competent-authority decision.

Chapter 29 establishes that United States public secure-facility doctrine is an authority, evidence and lifecycle framework rather than a catalogue of acoustic products. Intelligence Community, Department of Defense, industrial-security, DOE and civilian federal frameworks overlap at interfaces while retaining separate authority and vocabulary. [154]

Acoustic engineering contributes through source-state definition, complete-envelope analysis, construction surveillance, field measurement, uncertainty, maintenance and change control. It neither replaces electronic, cyber, physical or personnel security disciplines nor issues accreditation, reciprocity, facility clearance, SAP approval or another competent-authority decision.

Chapter 30 now examines United Kingdom public concepts for secure working areas, secure rooms and secure speech environments, preserving British institutional language and the public role of the United Kingdom National Authority for Counter-Eavesdropping.

154 MB-0913. International Organization for Standardization, ISO/IEC 17025:2017.

Chapter 29 Glossary

Accreditation. Authorised governmental determination that a facility satisfies the applicable requirements for a defined use.

Configuration drift. Uncontrolled divergence from the accredited or accepted physical and operating baseline.

ICD. Intelligence Community Directive.

ICS. Intelligence Community Standard.

Reciprocal use. Authorised reliance by another organisation upon an existing accreditation under defined conditions.

SAPF. Special Access Program Facility.

SCIF. Sensitive Compartmented Information Facility.

Technical specification. Detailed requirements subordinate to the applicable authority and edition.

Vulnerability. Condition susceptible to adverse consequence. It does not prove exploitation or compromise.

Accrediting official. Governmental official authorised to make the facility accreditation decision within the applicable programme.

Cognizant security authority. Organisation or official with security responsibility for interpreting and administering the applicable framework.

Co-use. Authorised use of a facility by more than one organisation or programme under defined conditions.

Configuration baseline. Controlled description of the physical, digital and operating state represented by the approval and evidence package.

Construction Security Plan. Approved plan translating security responsibilities and controls into project execution and field evidence.

Construction-surveillance technician. Qualified person assigned defined construction-surveillance functions under the controlling security plan.

Facility-related control system. Networked or programmable control system supporting building functions such as HVAC, power, alarms or access.

First-of-type. Initial representative installation used to verify buildability, interfaces, inspection and acceptance before repetition.

Guard band. Decision margin applied to account for measurement uncertainty or allocated conformity risk under an agreed rule.

Inspectable material. Material or component subject to authorised inspection and identity controls before incorporation into protected construction.

Joint-use. Facility use under shared or coordinated authority arrangements defined by formal agreement.

Material change. Physical, digital, operational, mission or access change capable of affecting the authorised baseline or decision.

NISPOM rule. 32 CFR Part 117, the federal rule governing the National Industrial Security Program for cleared contractors.

Reciprocity. Authorised reliance upon another organisation's existing accreditation under defined conditions and configuration equivalence.

Recommissioning. Repeat or targeted verification after time, maintenance, change, incident or observed drift.

SAPF. Special Access Program Facility authorised under the applicable Special Access Program authority.

SCIF. Sensitive Compartmented Information Facility authorised under the applicable Intelligence Community framework.

Security-minded information management. Proportionate control of facility information according to need, sensitivity, access, integrity and lifecycle.

Site Security Manager. Person assigned programme-defined management responsibilities for construction security at the project site.

Source freeze. Documented date and status at which controlling public sources are captured for a release or decision.

Technical Security Program. Programme governing technical-security activities under the applicable authority, distinct from general acoustic design.

UFC. Unified Facilities Criteria used for Department of Defense planning, design, construction and operation where applicable.

Whole-room evidence. Evidence representing the combined installed enclosure, services, states and accessible receiving conditions rather than one component.

Chapter 30. United Kingdom Secure Working Areas, Secure Rooms, Secure Speech Rooms, and Public Technical-Security Doctrine

United Kingdom practice uses institutional terms that should not be translated casually into United States or Canadian labels. A secure working area addresses a broader protected environment. A secure room addresses integrated physical protection. A secure speech room or environment addresses spoken information under defined conditions. Similar physics may apply, but authority, terminology and evidence routes differ.

The public framework emphasises proportionate protective security, layered controls, siting, physical protection, technical-security expertise and continuing assurance. Acoustic design should therefore be presented as one part of a risk-managed system, not as a theatrical promise of absolute silence.

Figure 30-1. United Kingdom secure-speech assurance aligns protective concept, national technical authority, evidence and continuing control. Author's original diagram.

30.1 Distinct public protective concepts

NPSA public guidance distinguishes secure working areas, secure rooms and secure speech rooms because they protect different functions and operate within different threat and access assumptions. Preserving those distinctions prevents a project from treating every protected space as one generic high-security room. [155][156][157][158]

A secure working area can include circulation, workstations, storage, services and controlled boundaries; a secure room concentrates protection

155 MB-0806. International Electrotechnical Commission, IEC 61672-2:2013.
156 MB-0807. International Electrotechnical Commission, IEC 61672-3.
157 MB-0803. International Electrotechnical Commission, IEC 61260.
158 MB-0984. JCGM 100:2008.

around a defined enclosure; secure speech focuses on the intelligibility or recovery of spoken information beyond the authorised environment. Each concept creates different source, path, receiver and governance questions; within distinct public protective concepts, the decisive analysis follows the complete source-path-receiver chain and records each interface capable of carrying pressure, force, information or measurement bias.

The owner requirements should identify which concept applies, which authority owns the decision and which public and controlled criteria govern. Drawings and specifications should not import SCIF, TCR or commercial labels as synonyms. The design record for distinct public protective concepts should translate those mechanisms into dimensions, products, tolerances, support conditions, inspection stages and named ownership.

The source register should preserve the exact public page, access date, terminology and limitation. Where a project uses several concepts, the interface and precedence should be stated. Shared vocabulary does not establish legal or technical equivalence across jurisdictions. Evidence concerning distinct public protective concepts should identify the exact observed unit, method, instrument chain, state, limitations and inference supported.

Worked example 30.1. Functional cross-reference count

A project brief contains 18 uses of the term secure room. Review shows that eight refer to a controlled working area, six to a protected speech environment, three to a physical-security enclosure and one is genuinely the defined secure-room concept.

E_t is the fraction of uses that match the intended defined term.

Only 5.6 per cent of the original uses are terminologically exact. The brief requires reconstruction before procurement.

The fraction is a document-quality screen, not an NPSA criterion or authority decision.

30.2 NPSA protective-security planning and siting

Public protective-security guidance emphasises understanding assets, threats, vulnerabilities and business needs before selecting measures. For speech protection, siting is often the most economical control. A room placed away from public circulation, accessible façades, shared service spaces and uncontrolled neighbours begins with a better risk posture. [159][160][161][162]

The building should be read in three dimensions. Roofs, ceiling voids, underfloor spaces, service risers, adjacent tenancies, plant rooms and external approaches can provide listener access or flanking paths. Existing buildings and heritage properties may constrain movement, mass and visible alteration. For npsa protective-security planning and siting, the mechanism must be traced from excitation through materials, supports, openings, controls and adjoining spaces rather than inferred from the trade name of one component.

Planning should map access populations, times, maintenance routes, construction constraints, source states and business continuity. The design should avoid unnecessary exposure and preserve space for doors, sound locks, services, ventilation and inspection. Accordingly, NPSA protective-security planning and siting require a controlled configuration with stable

159 MB-0801. International Electrotechnical Commission, IEC 60942:2017.
160 MB-0807. International Electrotechnical Commission, IEC 61672-3.
161 MB-0984. JCGM 100:2008.
162 MB-0997. JCGM 106:2012.

identifiers, coordinated details, access provisions and change triggers that remain usable after handover.

The planning evidence should record assumptions and authority decisions. Later tenancy or operational changes require reassessment because the original listener-access model may no longer apply. An isolated room within an uncontrolled surrounding system remains exposed through the paths and access that the planning stage failed to remove. Verification of npsa protective-security planning and siting should combine documentary reconciliation, direct observation and measurement without allowing one evidence class to substitute silently for another.

30.3 Secure speech environments and maximum credible vocal effort

FCDO Services publicly describes secure speech assessment in terms of whether spoken words can be understood outside the protected environment and refers to demanding vocal conditions. This functional approach is valuable because it connects construction to the actual information-bearing source rather than a product label. [163][164][165][166]

Vocal effort varies by talker, emotion, language, posture, distance and room response; short emphatic fragments and amplified conference audio can exceed ordinary averages; receiving background and listener access also change; a credible assessment therefore needs defined source and receiver states. The engineering model for secure speech environments and

163 MB-0998. Joint Committee for Guides in Metrology, JCGM GUM-1:2023 and JCGM GUM-6:2020, 2023 and 2020. Status at the 14 August 2026 source freeze: Published and current at source freeze. Public locator: Use is confined to the source scope. The docume.
164 MB-0278. ASTM International, ASTM E336-25a.
165 MB-0871. International Organization for Standardization, ISO 16283-1:2014.
166 MB-0816. International Organization for Standardization, ISO 10140-2:2021.

maximum credible vocal effort should identify which physical variables change with frequency, operating state, loading, access, maintenance and environmental condition.

The design basis should identify ordinary, raised and maximum authorised speech, installed audio, critical positions, background, masking, doors and services. Interior acoustics should support communication without forcing unnecessary effort. Design development should assign every consequential interface in secure speech environments and maximum credible vocal effort to a responsible discipline and should resolve acoustic, structural, fire, accessibility and service obligations together.

Testing should use authorised methods and competent personnel, preserve source level and spectrum, and distinguish standard room-pair measures from functional speech-security assessment; the competent authority decides whether the evidence supports the intended use; maximum-effort assessment does not mean shouting indiscriminately. It means a controlled, reproducible and authorised source condition; the acceptance record for secure speech environments and maximum credible vocal effort should preserve raw data, calibration, photographs, dimensions, processing and the decision rule needed for later reproduction.

30.4 United Kingdom NACE and technical-security authority

FCDO Services publicly identifies the United Kingdom National Authority for Counter-Eavesdropping as a national technical authority. The authority context matters because secure-speech work intersects with technical surveillance, electronic systems, construction and governmental approval.

Public service descriptions do not disclose every controlled method or threshold. [167][168][169][170]

Technical-security competence is task specific. An acoustician can measure sound and diagnose building paths; a counter-eavesdropping authority addresses broader technical threats and programme decisions; facilities, fire, structure, cyber and information-security roles remain distinct; a credible treatment of united kingdom nace and technical-security authority distinguishes direct transmission, structural coupling, connected air paths, regenerated sound and observational uncertainty before selecting a remedy.

Project governance should identify which technical authority reviews which proposition, how sensitive evidence is handled and how recommendations are converted into an authorised decision. Private consultants should not present themselves as the national authority or imply equivalence. The project documents should make united kingdom nace and technical-security authority buildable and inspectable by defining geometry, sequence, acceptable variation, substitute evidence and the point at which concealment is prohibited.

Reports should state the public source and the limitation of any analogy. Where controlled technical direction is supplied, it should remain within authorised channels and should not be reproduced in a public specification. Technical authority is institutional and cannot be created by adopting similar equipment or vocabulary. A favourable observation of united kingdom nace

167 MB-0806. International Electrotechnical Commission, IEC 61672-2:2013.
168 MB-0913. International Organization for Standardization, ISO/IEC 17025:2017.
169 MB-0871. International Organization for Standardization, ISO 16283-1:2014.
170 MB-0816. International Organization for Standardization, ISO 10140-2:2021.

and technical-security authority remains bounded to the inspected population and measured state, while unseen conditions and untested modes associated with united kingdom nace and technical-security authority remain explicit limitations.

30.5 Physical construction, doors, services and weak paths

United Kingdom secure-room physics is not unique. Lightweight partitions, masonry, concrete, doors, glazing, ceilings, floors, ducts, pipes, conduits and junctions follow the same acoustic principles. The institutional difference lies in the applicable authority, risk model and evidence process. [171][172][173][174]

A small gap, door seal, shared plenum, duct branch or structural flank can dominate. Heritage construction can contain hidden flues, voids and irregular walls. Raised floors and suspended ceilings can create routes inconsistent with a simple room outline. Analysis of physical construction, doors, services and weak paths begins by mapping the actual configuration, because small differences in geometry, restraint, continuity or software state can reverse the dominant path.

Design should trace the complete boundary and combine laboratory evidence with project-specific details, inspection and field verification; fire, accessibility, structure, moisture, conservation and services must be coordinated; mock-ups should include the controlling interfaces; a robust specification for physical construction, doors, services and weak paths

171 MB-0891. International Organization for Standardization, ISO 3382-2:2008.
172 MB-0913. International Organization for Standardization, ISO/IEC 17025:2017.
173 MB-0998. Joint Committee for Guides in Metrology, JCGM GUM-1:2023 and JCGM GUM-6:2020, 2023 and 2020. Status at the 14 August 2026 source freeze: Published and current at source freeze. Public locator: Use is confined to the source scope. The docume.
174 MB-0278. ASTM International, ASTM E336-25a.

combines performance language with prescriptive detail wherever the mechanism cannot be verified from a final single-number test.

Construction records should identify materials, layers, penetrations, doors, glazing, services, changes and test state. Controlled criteria should be applied by authorised reviewers without being restated in unrestricted documents. No national label repeals weakest-path physics. Testing of physical construction, doors, services and weak paths should report band data and operating conditions before any summary rating, so that background, flanking, drift and method scope can be examined.

Table 30-1. System, principal mechanism and required evidence.

System	Principal mechanism	Required evidence
Distinct public protective concepts	A secure working area can include circulation, workstations, storage, services and controlled boundaries	The source register should preserve the exact public page, access date, terminology and limitation
NPSA protective-security planning and siting	The building should be read in three dimensions	The planning evidence should record assumptions and authority decisions
Secure speech environments and maximum credible vocal effort	Vocal effort varies by talker, emotion, language, posture, distance and room response	Testing should use authorised methods and competent personnel, preserve source level and spectrum, and distinguish standard room-pair measures from functional speech-security assessment
United Kingdom NACE and technical-security authority	Technical-security competence is task specific	Reports should state the public source and the limitation of any analogy
Physical construction, doors, services and weak paths	A small gap, door seal, shared plenum, duct branch or structural flank can dominate	Construction records should identify materials, layers, penetrations, doors, glazing, services, changes and test state
TEMPEST, EMS, cyber and acoustic discipline boundaries	An equipment enclosure can influence electromagnetic and acoustic behaviour differently	Changes to equipment, cables, grounding, ventilation or enclosures should be screened by all affected disciplines
Construction assurance and security-minded information	The record needs stable identifiers, location, scale, date, author, approved device, original file, transfer, repository, permissions, review and retention	Handover should distinguish as-designed, as-installed, as-tested and as-authorised states

System	Principal mechanism	Required evidence
Testing, monitoring and continuing assurance	Baseline tests should identify source, receiver, room state, background, methods, equipment, calibration, uncertainty and authority	A change in result should be investigated for physical drift, operating state, instrumentation and processing before causal claims are made
Private-sector application without false governmental equivalence	A private project may adopt rigorous construction surveillance, maximum-effort testing, masking governance and change control	The final report should use precise language such as measured under the stated condition, rather than declaring the room government secure
Publication boundary and comparative use	Controlled methods, thresholds and facility-specific findings must not be reconstructed from service descriptions, procurement fragments or historical sources	Cross-jurisdictional conclusions should identify common engineering principles and separate institutional differences

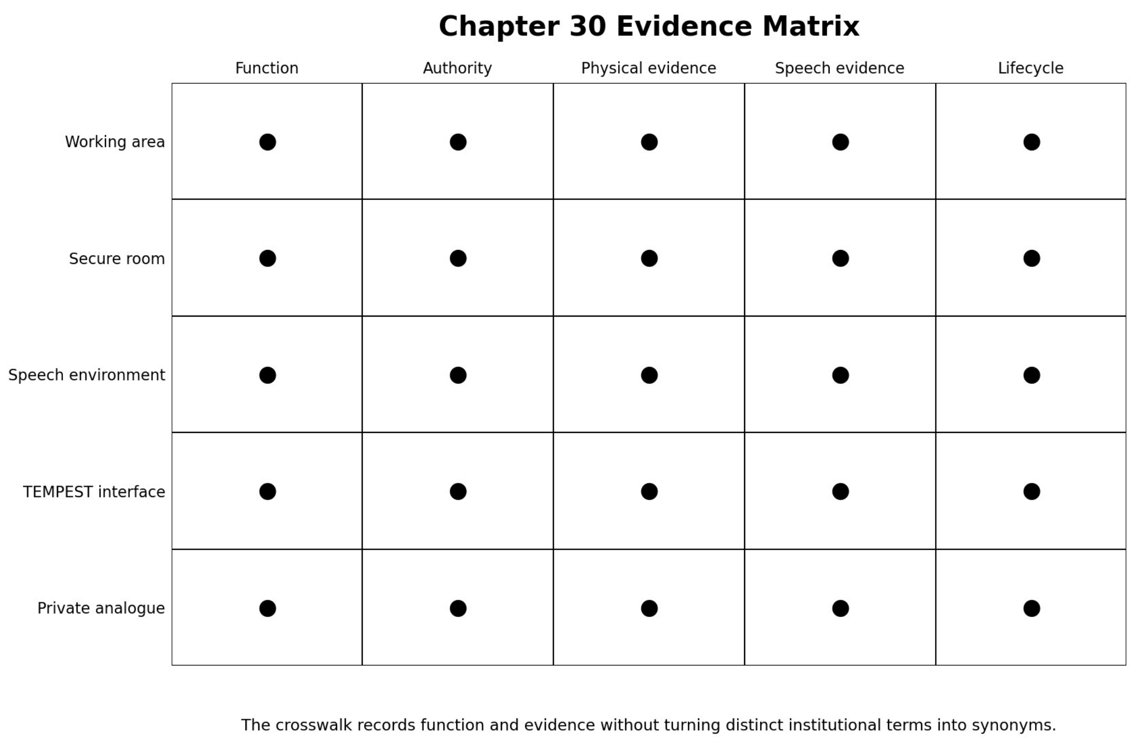

Figure 30-2. The crosswalk records function and evidence without turning distinct institutional terms into synonyms. Author's original diagram.

30.6 TEMPEST, EMS, cyber and acoustic discipline boundaries

NCSC public material describes TEMPEST and emanation-security functions. These questions concern compromising emanations and electronic security, not airborne sound isolation. They can share equipment, penetrations, power and physical boundaries, so coordination is essential without conflating methods. [175][176][177][178]

An equipment enclosure can influence electromagnetic and acoustic behaviour differently; a conductive penetration treatment may transmit structural vibration; an acoustic absorber may be irrelevant to emanations; networked conferencing can introduce cyber risk while also increasing the acoustic source. The controlling behaviour of tempest, ems, cyber and acoustic discipline boundaries is system dependent and cannot be reduced to one catalogue value when adjacent construction and services participate in the measured response.

The project should assign separate technical authorities and define interface reviews. Acoustic reports should not infer electronic security from low receiving sound, and TEMPEST or counter-eavesdropping reports should not be represented as field acoustic acceptance. Procurement and submittal review should preserve the tested or approved identity of tempest, ems, cyber and acoustic discipline boundaries, including the features whose alteration would invalidate comparison with the supporting evidence.

Changes to equipment, cables, grounding, ventilation or enclosures should be screened by all affected disciplines. The baseline should show which tests remain applicable. Integrated assurance is a coordinated set of bounded conclusions, not one universal pass. Where TEMPEST, EMS, cyber and acoustic discipline boundaries are evaluated by intervention, the record

175 MB-0871. International Organization for Standardization, ISO 16283-1:2014.
176 MB-0816. International Organization for Standardization, ISO 10140-2:2021.
177 MB-0891. International Organization for Standardization, ISO 3382-2:2008.
178 MB-0806. International Electrotechnical Commission, IEC 61672-2:2013.

should describe collateral changes and restoration duties before attributing the observed difference to one mechanism.

30.7 Construction assurance and security-minded information

Secure construction creates sensitive records. Drawings, images, access routes, technical findings and test data may reveal vulnerabilities. At the same time, concealed-work evidence is indispensable. United Kingdom projects should combine security-minded information management with technically sufficient observations. [179][180][181][182]

The record needs stable identifiers, location, scale, date, author, approved device, original file, transfer, repository, permissions, review and retention. Redaction or restricted distribution may be appropriate, but the original evidence must remain available to authorised reviewers. For the question addressed in section 30.7, construction assurance and security-minded information are examined as a time-varying network whose inputs, boundaries and receiver conditions must all remain explicit.

The construction-surveillance plan should align hold points with observable stages and define access, escorts, photography, material identity, nonconformance and closeout. Missed observations should not be converted into assumptions by administrative pressure. For construction assurance and security-minded information, the room data sheet and requirement matrix should state source states, adjoining access, operating modes, lifecycle duties and the accepting authority.

179 MB-0871. International Organization for Standardization, ISO 16283-1:2014.
180 MB-0816. International Organization for Standardization, ISO 10140-2:2021.
181 MB-0891. International Organization for Standardization, ISO 3382-2:2008.
182 MB-0228. ASTM International, ASTM E2235-04.

Handover should distinguish as-designed, as-installed, as-tested and as-authorised states. Security classification or handling marking should be applied by the responsible authority. Protecting evidence and producing evidence are not opposing goals when the information architecture is designed properly. The dossier for construction assurance and security-minded information should distinguish as-designed, as-submitted, as-installed, as-tested, as-authorised and as-operated states.

30.8 Testing, monitoring and continuing assurance

Public UK secure-speech descriptions include testing, monitoring and training, which reflects a lifecycle model rather than a one-off room rating. Doors wear, seals change, masking fails, equipment updates, and maintenance opens boundaries. Continuing validity requires observable indicators and response. [183][184][185][186]

Baseline tests should identify source, receiver, room state, background, methods, equipment, calibration, uncertainty and authority. Monitoring can cover masking, doors, access, equipment or other indicators, but it should not claim to measure what it does not observe. The physical inquiry into testing, monitoring and continuing assurance separates what carries energy from what merely appears defective, thereby preserving alternative hypotheses until discriminating evidence is obtained.

The assurance programme should include user checks, periodic inspection, event-driven testing, incident response, configuration review and training. Intervals should reflect consequence, wear and change frequency. Trend

183 MB-0806. International Electrotechnical Commission, IEC 61672-2:2013.
184 MB-0913. International Organization for Standardardization, ISO/IEC 17025:2017.
185 MB-0801. International Electrotechnical Commission, IEC 60942:2017.
186 MB-0807. International Electrotechnical Commission, IEC 61672-3.

analysis should use stable methods. The design team should provide maintainable routes, inspection access and authorised replacement criteria so that later work on testing, monitoring and continuing assurance does not silently alter the boundary.

A change in result should be investigated for physical drift, operating state, instrumentation and processing before causal claims are made. Corrective action should update the baseline. Continuing assurance is strongest when failures improve future specifications, training and observability. Inspection and measurement of testing, monitoring and continuing assurance should be scheduled while the controlling condition is still observable, with missed hold points treated as missing evidence rather than acceptance.

30.9 Private-sector application without false governmental equivalence

Private organisations can use UK public guidance to improve privileged meeting rooms, boardrooms, legal suites and research spaces. They should define their own authority, risk, source states and measurable outcomes rather than claiming government certification or secure speech room status by analogy. [187][188][189][190]

A private project may adopt rigorous construction surveillance, maximum-effort testing, masking governance and change control. It may use the same acoustic equations and standards. What it cannot do is manufacture national-authority approval or disclose controlled criteria it does not

187 MB-0998. Joint Committee for Guides in Metrology, JCGM GUM-1:2023 and JCGM GUM-6:2020, 2023 and 2020. Status at the 14 August 2026 source freeze: Published and current at source freeze. Public locator: Use is confined to the source scope. The docume.
188 MB-0913. International Organization for Standardization, ISO/IEC 17025:2017.
189 MB-0908. International Organization for Standardization, ISO 9614-1:1993.
190 MB-0909. International Organization for Standardization, ISO 9614-2.

possess. Evaluation of private-sector application without false governmental equivalence requires a scale-appropriate model, from local joint or support behaviour through room-level and whole-building consequences.

Specifications should state the intended private function, relevant public guidance, professional standards, test methods, limitations and accepting role. Marketing should avoid labels suggesting NPSA, NACE or government endorsement. Details governing private-sector application without false governmental equivalence should be coordinated in three dimensions, with movement, supports, penetrations, terminations and control states shown rather than left to site improvisation.

The final report should use precise language such as measured under the stated condition, rather than declaring the room government secure. Any future governmental use requires the proper authority and process. Functional excellence is compatible with institutional honesty. Reports on private-sector application without false governmental equivalence should separate observation, calculation, interpretation, residual alternatives and competent-authority disposition.

30.10 Publication boundary and comparative use

United Kingdom public sources are valuable for comparative scholarship because they articulate distinct concepts and national technical roles. Comparative work should map function, authority, evidence and lifecycle while preserving terms. It should not translate labels one for one. [191][192][193][194]

191 MB-0342. ASTM International, ASTM E966-18a.
192 MB-0871. International Organization for Standardization, ISO 16283-1:2014.
193 MB-0816. International Organization for Standardization, ISO 10140-2:2021.
194 MB-0209. ASTM International, ASTM E1332-22.

Controlled methods, thresholds and facility-specific findings must not be reconstructed from service descriptions, procurement fragments or historical sources. A public page may change, so access date and source status should be recorded. Archived material should be labelled historical. The mechanism associated with publication boundary and comparative use should be stated in measurable terms, including the quantities, directions, frequency bands and operational states that could control the result.

The monograph should explain physical mechanisms and professional process at full depth while placing a clear boundary around undisclosed criteria. Synthetic examples can demonstrate calculations without exposing actual facilities. The selected treatment of publication boundary and comparative use should remain effective under credible extremes, not merely under the convenient condition used for an early demonstration.

Cross-jurisdictional conclusions should identify common engineering principles and separate institutional differences. Chapter 32 will formalise that crosswalk method. A useful comparison illuminates differences rather than erasing them. A result for publication boundary and comparative use cannot be extended automatically to another room, product, geometry, season or software state without an explicit equivalence analysis.

Table 30-2. Release gate.

Gate	Controlling question	Minimum record	Failure response
Requirement	What outcome or bounded condition is required?	Source, owner, state and decision authority	Clarify or suspend the affected work
Configuration	What exact physical and operating state is represented?	Drawings, submittals, asset and route identifiers	Reconcile discrepancies before acceptance
Inspection	What conditions were directly observable before concealment?	Hold-point record, measurements and images	Open, reconstruct or carry a stated limitation

Gate	Controlling question	Minimum record	Failure response
Measurement	What quantity was measured, where, when and with what uncertainty?	Raw data, calibration, method, state and processing	Correct the method or repeat the test
Authority	Who may accept, condition, restrict or reject the result?	Signed disposition and limitations	Do not represent technical review as authorisation
Lifecycle	What later change can invalidate the result?	Baseline, maintenance and retest triggers	Reopen review and update the controlled record

30.11 Governance, departmental authority, and the three National Technical Authorities

United Kingdom protective security is governed through accountable organisations rather than through a single room label; the Cabinet Office functional standard and Security Policy Framework establish organisation-wide expectations; departmental boards, senior security leaders, Departmental Security Advisers, asset owners and project sponsors translate those expectations into risk decisions. NPSA, NCSC and UK NACE provide distinct national technical authority functions; their remits intersect, yet they are not interchangeable and should not be collapsed into a generic security approval role. [195]

A secure-speech project should identify the business owner, security authority, information owner, property authority, technical-security authority, approving official, designer, construction-security lead, testing body and operational custodian. The responsibility matrix should distinguish who writes requirements, who interprets protected criteria, who designs, who observes concealed work, who validates instruments, who accepts a defect, who authorises use and who retains the record. Consultants support

195 MB-0217. ASTM International, ASTM E1573-22.

that chain but do not silently acquire governmental authority through expertise or contract title.

Governance must survive personnel movement. Delegations, alternates, escalation periods, stop-work powers and evidence repositories should be recorded before procurement. A late change of Departmental Security Adviser or project sponsor can otherwise leave unresolved assumptions disguised as inherited decisions. The chapter therefore treats authority, technical evidence and use authorisation as separate links. The strongest acoustic report remains an engineering input until the responsible United Kingdom authority makes the decision required by the applicable policy and controlled criteria.

A decision ledger should record the question, initiating event, evidence considered, consultees, resolution, conditions, review date and authority signature. It should also show when a matter was referred because it exceeded delegated competence. This practice allows later reviewers to distinguish an informed governmental decision from an unexamined consultant assumption. Where authority is uncertain, the safe disposition is to preserve the evidence, restrict dependent work and obtain a written determination before the affected construction or operating state becomes irreversible.

Table 30-3. United Kingdom authority, role, evidence, and decision boundary.

Role	Primary function	Typical evidence	Boundary
Department or organisation	Owns mission, assets and business risk	Operational Requirement and governance decision	Does not replace national technical authorities
NPSA	National technical authority for protective security	Public guidance and specialist advice	Does not issue acoustic test results for every project

Role	Primary function	Typical evidence	Boundary
NCSC	National technical authority for cyber security and EMS/TEMPEST	Cyber and electromagnetic-security guidance	Does not establish airborne sound isolation
UK NACE	National technical authority for technical security and counter-eavesdropping	Technical-security advice, operations and testing	Controlled methods and thresholds remain protected
Engineering and testing team	Designs, measures and records defined mechanisms	Drawings, calculations, raw data and reports	Does not authorise governmental use

Worked example 30.2. Authority-chain coverage

A responsibility register contains 64 consequential decisions. Fifty-eight identify an originator, reviewer, verifier and authorised decision owner. Let C_a be authority-chain coverage, N_c the fully connected decisions and N_t the total decisions.

The documented authority-chain coverage is 90.6 per cent. Six decisions require assigned owners before concealment or acceptance.

The ratio measures documentary completeness only. It does not establish that an appointee possesses the required authority, clearance, competence or access to protected criteria.

30.12 Public-source hierarchy, controlled criteria, and configuration management

The public hierarchy begins with functional and policy-level material, then proceeds through classification policy, public NPSA guidance, public NCSC and UK NACE descriptions, consensus standards and project-specific records. Some detailed physical and technical-security standards are not publicly accessible. Their absence from open sources is not a licence to infer their contents from procurement language, historical commentary or a superficially similar foreign document. [196]

Every controlling source should be recorded with exact issuer, identifier, title, date, version, status, jurisdiction, access condition, project applicability and responsible interpreter. Public web pages also need an access date because their language and navigation can change without a conventional edition number. Project-controlled criteria require separate handling, authorised distribution and immutable version references. The design basis should never merge fragments from different source states into an apparently coherent but unauthorised composite.

When a source changes, the project evaluates technical effect. It does not replace text mechanically. The disposition should state whether the authorised baseline remains, whether the revision is adopted, whether a transitional arrangement applies, or whether the competent authority issues another instruction; superseded copies remain necessary for forensic reconstruction. Current copies support future decisions. Both must be distinguishable at a glance, much as a properly ordered bundle before the High Court separates controlling authority from historical background.

Source control also requires technical preservation; each controlling file should have a checksum, controlled filename, access classification, provenance record and relationship to the requirements database. A web page should be archived lawfully where policy permits, while its live locator and access date remain recorded; where protected material cannot appear in the ordinary project repository, the public register should still identify the

196 MB-0237. ASTM International, ASTM E2638-24.

existence of a separate authorised baseline without exposing its contents. This separation supports audit while respecting need-to-know restrictions.

Figure 30-3. United Kingdom public authority and source hierarchy, showing distinct policy, protective-security, cyber and technical-security functions. Author original diagram.

Worked example 30.3. Source-register integrity

A source register contains 52 potentially controlling records. Forty-eight state identifier, date, status, applicability and disposition. Let C_s be verified source-register integrity.

The source-register integrity is 92.3 per cent. Four unresolved sources must not control procurement or acceptance.

The screening ratio does not prove that the recorded sources were interpreted correctly or that protected project criteria were fully incorporated.

30.13 Operational Requirement process and threat-informed basis of design

NPSA public guidance places the Operational Requirement process before the selection of physical measures. This order is fundamental. The project first identifies assets, business functions, credible threats, access, consequence, resilience needs and operational constraints. It then states what the security solution must achieve. A manufacturer, wall system or conference-room product should not become the requirement merely because it is familiar, available or impressive in a polished catalogue. [197]

For secure speech, the Operational Requirement should define authorised discussions, source states, adjoining access, credible listening positions, hours of use, doors, glazing, HVAC states, communications equipment,

197 MB-0246. ASTM International, ASTM E2964-26.

cleaning, maintenance, emergency operation and expected change. It should also identify where acoustic control ends and other technical-security disciplines begin. The basis of design converts those functions into measurable and inspectable requirements while preserving uncertainties and authority decisions.

The Operational Requirement is maintained through the project lifecycle. Site discoveries, tenancy changes, new communications systems, revised classifications, altered operating hours and supply-chain concerns can invalidate an early assumption. Each material change should trace to the relevant risk, requirement, design response, verification method and decision owner. This chain prevents security from becoming a late architectural embellishment, rather than a controlled answer to a defined operational problem.

The Operational Requirement should include misuse and degraded-state cases, not merely the intended meeting. Examples include a door held ajar, a masking zone disabled, a maintenance panel removed, an emergency override active, a landlord entering an adjoining plant room, or a conferencing device placed in diagnostic mode. Each case should identify detectability, response and recovery. These scenarios sharpen acceptance testing because they reveal whether protection depends upon an unstated ideal condition that ordinary operations cannot reliably maintain.

Table 30-4. Operational Requirement chain for a secure-speech project.

Stage	Required question	Evidence output	Failure if omitted
Asset and business function	What must continue and what must remain protected?	Asset and use statement	Measures become product-led
Threat and access	Who can approach, observe or connect, and when?	Threat and access model	Listener geometry is incomplete

Stage	Required question	Evidence output	Failure if omitted
Operational states	How is the space actually used and maintained?	State matrix	Testing covers only a convenient state
Performance and authority	What must be demonstrated, and who decides?	Measurable requirement and decision owner	Engineering result is confused with approval
Lifecycle	What changes require review or retest?	Change and assurance plan	Initial acceptance decays silently

Worked example 30.4. Requirement-to-risk traceability

A project lists 40 security requirements. Thirty-six trace to a stated asset, threat, consequence, mitigation and verification method. Let C_r be requirement-to-risk traceability.

Ninety per cent of the requirements are fully traceable. Four untraced requirements should be justified, corrected or removed before tender.

The calculation tests documentary linkage. It is not an NPSA risk score and does not establish that the identified threat set is complete.

30.14 Secure working areas, secure rooms, secure speech rooms, and adjacent concepts

NPSA public guidance distinguishes a secure working area, where personnel work with sensitive information or assets, from a secure room used principally for storage, and from a secure speech room used for highly sensitive discussion. Protected spaces, strong rooms, vaults, server rooms and general controlled offices serve other purposes. Similar construction products may appear in several settings, but the protected function and threat model are not synonymous. [198]

The distinction affects geometry, occupancy, ventilation, egress, storage, communications, surveillance, staff behaviour and lifecycle testing; a

198 MB-0906. International Organization for Standardization, ISO 7235.

storage room may prioritise surreptitious and forcible entry resistance; a working area must support recurring occupancy and operational systems; a speech environment must manage conversational source states, listener access, acoustic paths and technical attack. Combining terms carelessly can import the wrong performance claim, approval route or operating assumption.

The owner's project requirements and room data sheet should therefore state the exact concept, authorised activities, protected assets, relevant authority and exclusions. A hybrid space requires explicit analysis of each function. The term secure should never be used as a decorative adjective. It is a bounded claim that must be tied to a defined institutional meaning, tested configuration and continuing control.

A room designation is therefore a governance shorthand, not a laboratory rating; the design team should translate the designation into room-specific functions, source conditions, access assumptions, environmental states, inspection rights, maintenance boundaries and authority decisions; any schedule using only labels such as secure room or speech room is incomplete. It can conceal conflicts between storage, occupancy, fire strategy, accessibility and technical-security needs; the project record should state which function prevails when those needs cannot be satisfied simultaneously.

Table 30-5. Public concept distinctions.

Concept	Primary public function	Typical occupancy	Principal caution
Secure working area	Work with sensitive information or assets	Recurring personnel activity	Not a synonym for a storage room or speech room
Secure room	Storage of sensitive information or large assets	Normally limited occupancy	Physical protection does not by itself prove speech security

Concept	Primary public function	Typical occupancy	Principal caution
Secure speech environment	Protection of sensitive discussions	Meetings and conferences	Requires acoustic and technical-security authority
Protected space	Protection of occupants or assets from blast effects	Emergency or defined protective use	Not a secure room merely because walls are substantial
Strong room or vault	High delay against forcible attack	Storage function	Different threat and performance proposition

Worked example 30.5. Terminology correction rate

A draft brief uses the term secure room 24 times. Review finds that 9 instances mean secure working area, 7 mean secure speech environment, 5 mean storage room and only 3 are exact. Let E_t be the terminology error fraction.

The terminology error fraction is 87.5 per cent. The brief requires reconstruction before design responsibility can be allocated reliably.

The fraction measures drafting precision. It does not determine which physical or technical-security measures any of the corrected spaces require.

30.15 Classification, information handling, and authorised use states

The Government Security Classifications Policy provides an administrative framework for OFFICIAL, SECRET and TOP SECRET information, together with baseline behaviours and additional markings. Classification informs consequence and handling. It does not, by itself, specify a complete room construction or acoustic performance. The protected use must be translated into a facility-specific operating proposition by the responsible organisation and technical authorities. [199]

199 MB-0798. International Electrotechnical Commission, IEC 60268-16:2020.

A secure-speech room can have several authorised and prohibited states. These may include ordinary discussion, raised vocal effort, installed conferencing, visiting delegations, interpreters, classified display, equipment maintenance, emergency evacuation, cleaning and temporary outage of masking or monitoring. Each state changes the source, receiver, access or technical system. The operating concept should identify which combinations are permitted, conditionally permitted or prohibited.

Information handling also governs drawings, test data, photographs, defect records and maintenance logs. A low classification or public document can become sensitive when aggregated with location, geometry and vulnerability information. The project should assign handling based on content and consequence, not file extension. At handover, the as-designed, as-installed, as-tested and as-authorised states must remain distinguishable.

Classification and handling policy influence acoustic engineering indirectly through consequence, occupancy and permitted operating states. A change in the information handled can alter the required listener model, source level, duration of exposure, adjoining-zone control and incident response. The room should not be assumed suitable for a higher sensitivity merely because its construction remains unchanged. Reclassification requires review of the authorised proposition and of every dependency, including staff procedures, communications equipment, maintenance access and records retention.

Worked example 30.6. Credible operating-state count

A room has four meeting states, three HVAC states, two masking states and two access-control states. Let N_c be the number of combinations if the variables can coexist independently.

Forty-eight combinations exist before emergency and maintenance states are added. The commissioning plan should select the credible and consequential combinations.

The product assumes independent state variables. Interlocks may remove combinations, while hidden software or human states may add others.

30.16 Siting, adjacency, overlooking, and listener-access geometry

Siting is often the most economical security control because distance, controlled adjacency and reduced line of sight can remove difficult attack opportunities before construction begins. A room beside a public corridor, shared roof, landlord plant room or neighbouring tenancy requires a different design from one embedded within a controlled core. NPSA public guidance accordingly emphasises location away from public areas and overlooking where practicable. [200]

The adjacency study should read the building in plan, section and service topology. Potential access includes roofs, façades, ceiling voids, raised floors, risers, service corridors, loading bays, car parks, maintenance cradles and future tenant areas. Remote spaces can remain acoustically connected by ductwork, pipework, structural frames or cable routes. Time also matters.

200 MB-0999. Joint Committee for Guides in Metrology, JCGM GUM-5:2026, Guide to the expression of uncertainty in measurement.

A low-occupancy space may become accessible to cleaners or contractors after hours when background sound is lower.

The register should identify each receiving zone, who can enter it, when access occurs, what equipment can be placed there, and which barrier or control interrupts the path. Changes in lease, estate operation or maintenance rights trigger review. A favourable room-average test cannot cure an unexamined accessible position. Security is determined by the most consequential credible source-path-receiver combination, not by the quiet dignity of the architectural plan.

Listener-access geometry should be time resolved. A location that is inaccessible during normal hours may become credible during cleaning, deliveries, night maintenance or emergency response. Conversely, a theoretically close position may be controlled continuously by physical barriers and supervision. The adjacency register should therefore combine distance, line of sight, acoustic path, access population, dwell time and detectability. This produces a more defensible threat model than a plan marked only with concentric distance bands around the protected room.

Table 30-6. Adjacency and access-zone register.

Zone	Access population	Time state	Principal path	Control or evidence
Public corridor	Visitors and general staff	Business hours	Door, wall and ceiling	Setback, lobby, tested boundary
Roof or façade access	Maintenance contractors	Planned and emergency access	Glazing, roof and plant	Controlled access and line-of-sight review
Landlord plant room	Landlord and service staff	Day and night maintenance	Ducts, pipes and structure	Lease controls and path testing
Neighbouring tenancy	Future or current tenant	Variable occupancy	Façade cavity and structure	Lease review and whole-envelope analysis

Zone	Access population	Time state	Principal path	Control or evidence
Riser or service void	Authorised technicians	Maintenance periods	Penetrations and conduits	Registered services and inspected closures

Worked example 30.7. Access-weighted exposure index

Three adjoining zones have access probabilities 0.10, 0.25 and 0.05 during protected use, with consequence weights 4, 2 and 5. Let I_a be the sum of probability multiplied by weight.

The screening index is 1.15 weighted units. The first and second zones dominate and deserve priority in siting or access-control decisions.

The weights are project-defined and are not governmental risk ratings. Correlated access and unmodelled attack capability can change the ranking.

30.17 Existing buildings, leases, heritage fabric, and retrofit uncertainty

Existing buildings conceal history. Walls may contain abandoned flues, blocked openings, undocumented linings, mixed masonry, voids, ducts or later services. Leasehold occupation can limit access to façades, roofs, risers and landlord plant. Heritage constraints can restrict destructive investigation and irreversible work. A secure-speech retrofit therefore begins with evidence of what exists, not with confidence in a drawing that may have survived several refurbishments and cups of tea. [201]

The survey should combine records, visual inspection, dimensional checks, borescope work, targeted opening, material identification, acoustic measurement, vibration testing and service tracing. Uncertainty is spatial. One inspected bay does not prove every bay. The team should record

201 MB-0816. International Organization for Standardization, ISO 10140-2:2021.

inaccessible areas, inferred construction and confidence. The remediation strategy can use reversible inner enclosures, independent services or relocation when uncertainty cannot be reduced economically.

Lease and conservation decisions belong in the security model. Landlord rights, emergency access, maintenance windows and reinstatement obligations can undermine assumptions made during design. The risk register should distinguish a physical limitation from an administrative promise. Retrofit acceptance must remain bounded to the observed and tested configuration, with explicit residual uncertainty and event-driven reassessment.

Retrofit uncertainty should be expressed as testable hypotheses. Hidden cavities, undocumented openings, mixed wall leaves, abandoned services and heritage restrictions can each become separate investigation items with stated evidence thresholds. The survey plan should rank non-invasive inspection, targeted measurement, borescope access and authorised opening according to consequence and reversibility. Where evidence remains incomplete, the basis of design should carry a bounded allowance or operational restriction rather than silently treating the existing fabric as homogeneous and fully known.

Worked example 30.8. Survey confidence allocation

A perimeter has 18 structural bays. Six are opened directly, four are examined by borescope and eight are inferred from records. Assign confidence factors 1.0, 0.7 and 0.3. Let C_b be the average weighted confidence.

The average screening confidence is 62.2 per cent. The eight inferred bays dominate residual uncertainty and should be targeted if consequence warrants.

The factors are analytical assumptions, not official inspection grades. Repetition, workmanship variation and concealed local defects may reduce confidence further.

30.18 Complete-envelope analysis and weakest-path control

A secure-speech boundary is a network of parallel airborne, structure-borne, duct-borne and equipment-mediated paths. Walls, floors, ceilings, doors, glazing, ducts, pipes, conduits, joints and openings contribute simultaneously. The highest-rated element does not govern the total. A modest gap or service route can dominate a heavy enclosure, much as one unsound witness can destabilise an otherwise formidable case. [202]

Analysis should convert each path to a common linear quantity before combination. Area, source coupling, receiving geometry, absorption and state matter. Direct and flanking paths must be separated where evidence permits. The model is tested by intervention and measurement. If temporarily sealing one path changes the total less than predicted, the model may have double-counted it or omitted another route.

Weakest-path control is not merely a design maxim. It governs inspection, commissioning and maintenance. The path register should state mechanism, location, evidence, uncertainty, authorised state, control owner and trigger. Acceptance should address the complete envelope under

202 MB-0891. International Organization for Standardization, ISO 3382-2:2008.

defined conditions rather than a collection of favourable component certificates.

The complete-envelope model should maintain a path register in linear energy terms, even when results are reported in decibels; direct partitions, doors, glazing, ducts, plenums, structure, service penetrations and temporary openings are parallel contributors; a high-performing wall cannot compensate arithmetically for an open path. Sensitivity analysis should identify which uncertain path can change the decision, while diagnostic interventions should test that ranking; the resulting weakest-path doctrine is physical and evidential, not a slogan about selecting the thickest construction.

Worked example 30.9. Parallel-path sound reduction

Two equal-area paths have sound reduction indices R_1 = 58 dB and R_2 = 38 dB. Let tau_i = 10^(-R_i/10), and let R_tot be the combined result for equal areas.

The weaker path reduces the combined result to approximately 41 dB despite the 58 dB companion path. Remediation should address the 38 dB route first.

The example assumes equal areas and incoherent power addition. Real fields, flanking, leakage and source directivity can change the installed result.

30.19 Doors, lobbies, seals, thresholds, and disciplined operation

Doors combine structure, hardware, moving seals, human use and life-safety obligations. A heavy leaf with an excellent laboratory rating can perform poorly when the frame is twisted, the threshold is uneven, the drop seal is misadjusted or the closer fails to latch. Security also depends on whether users prop the door, admit visitors, defeat an interlock or conduct sensitive speech while the leaf is moving. [203]

The design should coordinate leaf, frame, seals, threshold, hinges, lock, closer, access control, emergency release, fire performance, accessibility and wall attachment as one tested and maintainable system. A lobby or sound lock can reduce direct exposure, but only when door sequencing and occupancy are understood. Hardware substitutions require evidence because seemingly equivalent products alter geometry, stiffness, closing force and service life.

Commissioning should map perimeter compression, closing speed, latch engagement, floor variation, automatic operators, access states and emergency modes. Maintenance records should include adjustments and replaced parts. A daily user check can identify gross failure, but it does not replace periodic technical inspection. The authorised operating procedure should define what happens when a seal, closer or interlock is defective.

Door assurance should include a state matrix covering fully latched, closing, unlocked, access-controlled, emergency released, propped, degraded seal and post-maintenance conditions. Repeated cycling can reveal hinge settlement, closer drift and threshold contamination that a single acceptance closure misses. The record should distinguish leaf, frame, perimeter seal, automatic drop seal, threshold, hardware preparation and wall interface. Operational rules must also specify who may adjust the

203 MB-0801. International Electrotechnical Commission, IEC 60942:2017.

assembly, what constitutes a reportable defect, and when sensitive use must stop.

Worked example 30.10. Door-open exposure time

A door opens 14 times during a 90-minute protected meeting. The mean open duration is 5 seconds. Let f_o be the fraction of meeting time with the door open.

The door is open for approximately 1.30 per cent of the meeting. Even this small fraction can dominate consequence if speech coincides with an accessible receiving position.

The calculation does not model speech timing, lobby attenuation, listener presence or the possibility of a single high-consequence disclosure.

30.20 Glazing, façades, optical exposure, and laser-eavesdropping interfaces

Glazing is simultaneously an acoustic leaf, optical aperture, structural system, weather barrier and potential technical-security interface. Performance depends on pane mass, asymmetry, cavity, frame, edge seals, vents, mullions and the complete façade junction. A high nominal glass rating can be defeated by a perimeter gap, trickle vent, lightweight spandrel or contiguous façade cavity. [204]

Public UK NACE guidance notes that laser eavesdropping can exploit vibration of hard room objects or glazing from a remote line of sight. Acoustic improvement alone does not prove optical protection. Siting, external observation points, blinds, curtains, room arrangement, reflective

204 MB-0998. Joint Committee for Guides in Metrology, JCGM GUM-1:2023 and JCGM GUM-6:2020, 2023 and 2020. Status at the 14 August 2026 source freeze: Published and current at source freeze. Public locator: Use is confined to the source scope. The docume.

objects, glazing vibration and specialised technical-security advice must be considered together. The report should avoid turning a public awareness article into a controlled design standard.

Inspection should include frame anchors, gaskets, sealant depth, drainage, mullion continuity, adjacent panels and access for maintenance. Tests should use several source and receiver positions because pane modes and structural coupling vary. Where heritage windows are retained, secondary glazing can create useful separation but also resonant cavities and concealed maintenance zones. The accepted state must record blinds, ventilation openings and façade-access conditions.

Glazing assessment should combine acoustic and optical geometry without assuming that one discipline subsumes the other. The pane, frame, gasket, mullion, cavity, blind, façade access route and external line of sight each require a defined owner. Acoustic measurements may locate airborne leakage or structural response, but they do not determine vulnerability to every optical technique. Where specialist advice is required, the project should preserve the shared geometry and operating states so that separate technical assessments examine the same configured window system.

Table 30-7. Glazing and optical-technical-security interface.

Feature	Acoustic mechanism	Technical-security concern	Required evidence
Pane and cavity	Mass, stiffness, resonance and coincidence	Vibration under optical interrogation	Glazing specification and specialist review
Frame and gasket	Perimeter leakage and structural coupling	Accessible hardware and disturbance	Installation inspection and maintenance baseline
Mullion or façade cavity	Flanking and shared void transmission	Remote access through façade system	Section survey and diagnostic measurement

Feature	Acoustic mechanism	Technical-security concern	Required evidence
Blinds or curtains	Interior absorption and limited obscuration	Line-of-sight management	Authorised operating state and specialist advice
Vent or opening light	Direct airborne path	Accessible opening and observation	Interlock, operating restriction and test state

Worked example 30.11. Line-of-sight exposure fraction

A façade contains 12 glazed panels. Four have direct line of sight from credible external positions, three have partial line of sight, and five have none. Assign exposure factors 1.0, 0.5 and 0. Let E_g be the mean screening exposure.

The screening exposure is 45.8 per cent. Siting, obscuration and technical-security review should focus first on the seven exposed or partly exposed panels.

The factors are not laser-attack probabilities or UK NACE criteria. Reflection, distance, vibration, atmosphere and hostile capability are omitted.

30.21 HVAC paths, silencers, plenums, airflow, and pressure states

Ventilation preserves habitability but creates direct and flanking paths. Supply and return ducts, transfer grilles, shared plenums, ceiling voids, access doors, dampers, fan casings and plant-room connections can convey speech or regenerate noise. The path changes with damper position, fan speed, filter condition, balancing and night mode. A favourable daytime background can disappear when plant reduces after hours. [205]

The design should trace each air route from source space to every accessible receiver. Duct attenuation, breakout, cross-talk, silencer insertion

205 MB-1046. National Institute of Standards and Technology, FIPS PUB 180-4, Secure Hash Standard.

loss, regenerated noise and pressure loss must be considered together. A long silencer that cannot be fitted, inspected or cleaned is not a real control. Fire and smoke dampers, maintenance access and hygiene requirements cannot be ignored to improve acoustics.

Commissioning should test credible airflow and control states, preserve fan and damper settings, and distinguish useful masking from unstable plant noise. Temporary shutdown can diagnose a path but does not represent normal use. The operating baseline should record minimum permitted plant state and the response to filter replacement, balancing, controller change or unexpected quiet conditions.

HVAC verification should use an operating-state matrix rather than one nominal fan condition. Supply and return airflows, variable-volume boxes, dampers, night setback, purge, smoke control, maintenance isolation, filter loading and plant failure can alter both transmission and background. Measurements should record airflow, pressure, damper position, fan speed and access-panel condition. If security depends upon a minimum background or a particular damper state, that dependency requires monitoring, alarm response, operating authority and a defined safe condition during loss of service.

Worked example 30.12. Duct attenuation budget

A duct path begins at 82 dB in a source plenum. Straight duct, elbows, silencer and terminal provide 9, 7, 24 and 6 dB of insertion or propagation loss. Let L_r be the predicted receiving level before breakout correction.

The screening receiving level is 36 dB before background, flanking, regenerated noise and uncertainty are considered.

Insertion losses may not add independently, and catalogue data may not match installed airflow, dimensions, frequency bands or boundary conditions.

30.22 Utilities, penetrations, fire-stopping, and maintainable interfaces

Pipes, conduits, cable trays, drains, sprinklers, medical gases, fibre, copper and controls cross the protected boundary because buildings must function. Each crossing creates an air path, structural bridge, service cavity or future alteration point. A visually neat surface bead can conceal an empty annulus, discontinuous backing or a metallic sleeve that bypasses resilient construction. [206]

Details should coordinate acoustic closure, fire resistance, smoke control, movement, moisture, electrical safety, bonding, inspection and replacement. The exact tested firestop configuration matters. An acoustic substitution can invalidate a fire system, while an unplanned firestop repair can stiffen an isolated assembly. Penetration registers should record location, service, sleeve, annulus, backing, sealant, fire system, installer, inspection and change history.

Maintainability is a security property. Filters, valves, inspection points and cable routes should be serviceable without uncontrolled opening of the boundary. Spare capacity needs governance because it attracts later use. Abandoned services should be traced and closed in a verifiable manner. Every minor works request should be screened for boundary effect before drilling begins.

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206 MB-1245. U.S. Department of Defense, UFGS 01 91 00.15, Building Commissioning.

Every penetration should have a durable identity linked to service type, route, sleeve, annulus, fire and smoke system, acoustic treatment, movement requirement, installer, inspection status and later modification history. Photographs alone are insufficient if scale, orientation and exact location are unknown. The register should survive handover and remain accessible to authorised maintenance personnel. A new cable, pipe or temporary lead should trigger review before work begins, because a small unrecorded opening can dominate a boundary designed around much stronger elements.

Worked example 30.13. Geometric opening fraction

A wall has 40 service penetrations. Survey finds a total residual open annulus of 0.012 square metres in an 84 square metre boundary. Let f_A be the open-area fraction.

The geometric opening fraction is 0.0143 per cent. Such a small fraction can dominate a high-isolation boundary if it remains acoustically open.

The calculation treats openings as free apertures and does not predict a rated result for real firestop, sleeves, cavities or flanking paths.

30.23 Structure-borne sound, plant vibration, and supporting construction

Speech and equipment vibration can enter floors, walls, frames, glazing and services, then re-radiate remotely. Plant, pumps, loudspeakers, door operation and building-control actuators add other excitation. Structure-borne paths are especially important where heavy elements continue beyond the room or where resilient linings are bridged by supports, fixings, services or debris. [207]

The investigation should combine structural drawings, junction mapping, mobility or transfer measurements, accelerometers, controlled excitation and intervention. A level difference between two points shows attenuation under the measured condition but does not identify the path alone. Sensor mounting, orientation, mass loading, coherence and background vibration must be recorded.

Remediation may involve source isolation, support changes, discontinuity, damping, resilient interfaces or relocation. Each action can affect structure, fire, services and maintainability. The accepted detail should be inspectable and robust against later tightening, load changes or maintenance. A pristine resilient hanger that is later short-circuited by a rigid safety wire is an assurance failure, not merely untidy workmanship.

Structure-borne diagnosis benefits from transfer functions and operating-state comparison; measurements at the source machine, supports, connected structure and receiving surfaces can separate changing excitation from changing transmission; the test record should preserve sensor orientation, mounting, calibration, coherence and operating load. A reduction at one point does not prove that total radiated sound has fallen if energy has shifted to another path; remediation should therefore be verified at the protected room and relevant adjoining positions, not solely at the isolated plant item.

207 MB-1052. National Institute of Standards and Technology, NISTIR 8387, Digital Evidence Preservation: Considerations for Evidence Handlers.

Worked example 30.14. Directional vibration level difference

A structural sensor measures 78 dB re 1 nanometre per second on the source-side frame and 56 dB on the receiving-side frame under the same excitation. Let D_v be the directional vibration level difference.

The measured directional difference is 22 dB. It supports comparison of the tested junction state and helps prioritise interventions.

The result is not a universal junction constant. Mounting, wave type, frequency, geometry, coherence and other structural paths remain relevant.

30.24 Room acoustics, vocal effort, masking, and source-state discipline

A secure-speech environment must support intelligible conversation inside while limiting recoverable speech outside. Excessive reverberation can encourage raised voices, reduce internal clarity and alter spatial coupling. Very absorptive treatment can reduce source build-up but may expose a direct leakage path. The design therefore balances reverberation, source directivity, seating, finishes, background and operational behaviour. [208]

FCDO Services publicly describes secure conference rooms adjusted for the surrounding environment and safe use at maximum vocal effort. That description establishes a functional principle, not a public threshold. The project should define calibrated source states, including ordinary speech, raised speech, emphatic fragments and installed amplification. Masking, where authorised, must be spectrally appropriate, spatially uniform, stable and monitored.

208 MB-0801. International Electrotechnical Commission, IEC 60942:2017.

Testing should preserve source level, spectrum, position, room condition, background, listener geometry and language assumptions. A room may suppress ordinary sentences yet leak digits, names or commands. Reverberation and speech-intelligibility metrics support analysis but do not replace the competent authority's acceptance method. User procedures should address shouting, loudspeaker use, door opening and quiet-hour operation.

Room-acoustic control should be linked to the protected speech task; reverberation, source directivity, talker position, group size, teleconference reinforcement and participant behaviour can change vocal effort and repetition; a comfortable room may still encourage intelligible leakage if speech is amplified or frequently repeated. Commissioning should include representative layouts and source states, while operating guidance should address seating, microphone use and door discipline; masking, where authorised, remains a controlled active system with power, zoning, fault and maintenance dependencies.

Worked example 30.15. Equivalent absorption and reverberation estimate

A room has volume V = 180 cubic metres and measured reverberation time T = 0.72 seconds. Using the Sabine screening relation, let A be equivalent absorption.

The screening equivalent absorption is approximately 40.3 square metres. This supports comparison of finish changes and source build-up.

The relation assumes a sufficiently diffuse decay and uniform absorption. Coupled volumes, non-linear decay, low-frequency modes and source directivity may invalidate the estimate.

30.25 Secure conferencing, audiovisual equipment, telephony, and sensors

Modern meeting rooms contain ceiling microphones, loudspeakers, conference bars, cameras, displays, touch panels, network switches, occupancy sensors and building-control interfaces. These systems change acoustic source states, create penetrations and supports, and introduce remote management. A mute indicator can be a software state rather than a physical disconnection. A diagnostic microphone can remain active when the user believes the system is idle. [209]

The approved configuration should identify every device, firmware version, interface, cable, account, service, cloud dependency, maintenance route and permitted operating state. Acoustic, cyber and technical-security authorities should review their own mechanisms and the interfaces between them. A favourable field-isolation test does not authorise a networked microphone, while cyber approval does not prove that a ceiling loudspeaker will not excite a structural path.

Commissioning should exercise normal, muted, standby, update, fault, emergency and maintenance states. Configuration exports, logs, certificates and hashes should be preserved where authorised. Later firmware or equipment changes require screening because signal processing, gain,

209 MB-0998. Joint Committee for Guides in Metrology, JCGM GUM-1:2023 and JCGM GUM-6:2020, 2023 and 2020. Status at the 14 August 2026 source freeze: Published and current at source freeze. Public locator: Use is confined to the source scope. The docume.

beamforming, remote diagnostics and fan operation can change without visible construction work.

Audiovisual equipment should be assessed through a state and data-flow inventory; microphones, loudspeakers, cameras, displays, codecs, USB peripherals, wireless interfaces, diagnostic services and building sensors can change function after software updates or remote administration; the approved baseline should record hardware, firmware, configuration, network relationships, credentials, logging and maintenance access. Acoustic muting is not necessarily electronic disconnection; a visible standby indication also does not prove that microphones, radios, processors or telemetry functions are inactive.

Worked example 30.16. System-state combination count

A conference system has three microphone states, three loudspeaker states, two camera states, two network states and two maintenance states. Let N_s be the maximum combination count.

Seventy-two combinations exist before room, access and HVAC states are included. Testing should select credible high-consequence states rather than one nominal demonstration.

The product assumes independent states. Interlocks may remove combinations, while hidden diagnostic or cloud states may add others.

30.26 Acoustic, TSCM, TEMPEST, EMS, RF, cyber, and physical-security boundaries

Acoustic isolation, technical surveillance countermeasures, TEMPEST, electromagnetic security, RF security, cyber security and physical protection address different mechanisms. NCSC publicly distinguishes passive TEMPEST phenomena from the wider EMS field. UK NACE describes technical-security work that includes physical, electromagnetic and acoustic examination. NPSA addresses protective security. The disciplines collaborate, but one result cannot be substituted for another. [210]

A conductive enclosure can alter ventilation and structure-borne sound; an acoustic absorber may be irrelevant to electromagnetic leakage; a fibre link can reduce one conductive path while introducing powered media converters; a radio survey may identify environmental signals without proving the absence of a device. The interface register should state mechanism, authority, evidence, residual limitation and change trigger for each discipline.

Reports should use precise verbs. Measured sound isolation supports an acoustic proposition; a TSCM inspection addresses the scope and date of the technical search; TEMPEST product certification concerns the examined product and production assurance; Cyber authorisation addresses defined systems and controls; physical-security acceptance concerns barriers, access and detection. Integrated assurance is coordinated evidence, not semantic fusion.

A discipline-boundary register should identify each threat mechanism, responsible technical authority, required evidence, dependencies and escalation route. It should also state which conclusions one discipline may not draw from another discipline's result. For example, strong field sound isolation does not demonstrate absence of surveillance equipment, while a TSCM inspection does not establish future acoustic performance. Shared

210 MB-1046. National Institute of Standards and Technology, FIPS PUB 180-4, Secure Hash Standard.

drawings and configuration records improve coordination, but final opinions must remain within the competence, scope and authority of the specialist who issues them.

Table 30-8. Discipline boundary matrix.

Discipline	Principal mechanism	Representative evidence	What it does not prove
Architectural acoustics	Airborne and structure-borne transmission	Field spectra, path diagnosis and room state	Absence of electronic surveillance
TSCM	Technical surveillance vulnerabilities and devices	Physical and technical search record	Perpetual absence of future devices
TEMPEST and EMS	Compromising electromagnetic emanations	Product, installation or operational assessment	Speech isolation or physical entry resistance
Cyber security	Connected systems, identities, software and data	Authorisation, controls, logs and configuration	Acoustic performance of the room
Physical security	Barriers, access and detection	Operational Requirement, tested products and inspections	Technical-security or cyber assurance

Worked example 30.17. Interface-review coverage

A project identifies 30 cross-discipline interfaces. Twenty-seven have an owning authority, review method, evidence record and change trigger. Let C_i be interface-review coverage.

The documented interface-review coverage is 90.0 per cent. Three unowned interfaces remain potential assurance gaps.

The ratio does not prove the adequacy of the reviews or establish that all technical attack mechanisms have been identified.

30.27 UK NACE TSCM inspections and vulnerability assessment

UK NACE publicly describes TSCM as a holistic examination of technical-security weaknesses involving physical boundaries, human behaviour, physical search and technical search of electromagnetic and acoustic environments. This scope is broader than a conventional acoustic survey. It also remains bounded to the inspected condition, equipment, access and methods. A sweep is not a perpetual certificate of absence. [211]

Preparation should preserve the operational state and avoid alerting a suspected adversary. Asset owners should define the reason for examination, information sensitivity, incident history, recent works, access records, equipment changes and areas of concern. Investigators need lawful authority, controlled access and evidence-handling arrangements. Routine repairs before inspection can erase indicators and make causal reconstruction impossible.

The resulting record should distinguish observations, anomalies, confirmed devices, vulnerabilities, limitations and recommendations. Acoustic anomalies may justify targeted building investigation; electromagnetic anomalies may require other specialist analysis. A finding of weak boundary construction does not prove exploitation, while failure to locate a device does not prove that protected speech is safe in every future state.

TSCM should be planned as a bounded examination with a defined time, configuration, access scope, threat basis and reporting authority; the value of an inspection depends upon environmental control, equipment state, examiner access and preservation of anomalies. A clear result is not perpetual assurance; subsequent works, device changes, visitor access or hostile opportunity can alter the condition; the lifecycle plan should therefore connect TSCM findings to incident reporting, change control,

211 MB-1245. U.S. Department of Defense, UFGS 01 91 00.15, Building Commissioning.

monitoring and periodic or event-driven reassessment under UK NACE governance.

Worked example 30.18. Inspection anomaly rate

A technical-security inspection examines 240 defined locations and records 18 anomalies requiring disposition. Let r_a be the anomaly rate per inspected location.

The observed anomaly rate is 7.5 per cent. The result supports workload planning and trend comparison after consistent location definitions.

The rate does not measure compromise probability. Anomalies differ greatly in consequence, and uninspected or inaccessible locations remain outside the denominator.

30.28 Construction security, site security management, and technical observation

Construction and refurbishment expose the building fabric, delivery routes, temporary services and supply chain. UK NACE publicly identifies this period as especially vulnerable because hostile systems or security weaknesses can be embedded before closure. Technical security oversight must therefore begin before mobilisation and continue through preparation, construction, commissioning and final inspection. [212]

The construction-security plan should define perimeter and access control, personnel vetting, escorts, zoning, photography, material screening, delivery inspection, secure storage, waste, temporary power and communications, incident response, technical monitoring and observation of vulnerable work. Hold points should align with the moment a condition is

212 MB-0801. International Electrotechnical Commission, IEC 60942:2017.

visible. A post-hoc photograph of a closed wall cannot establish internal continuity.

Site security managers and technical-security observers work with the sponsor, clerk of works, designers and contractors without becoming substitutes for ordinary quality, safety or professional duties. Records should preserve who observed what, when, under which drawing and source state, and how anomalies were resolved. Missed observation requires an authorised recovery plan, not a retrospective assertion that the contractor is reputable.

Construction-security evidence should demonstrate observation quality, not merely attendance; records should identify the observer, competence, clearance or authorisation, location, work package, time, concealed feature, expected configuration, observed condition, discrepancy and release decision; wide photographs establish context, while close images and dimensions establish detail. When required observation is missed, retrospective confidence must not be invented; the competent authority should select an authorised recovery method, which may include opening, testing, restriction, reconstruction or explicit acceptance of bounded residual uncertainty.

Table 30-9. Construction-security control and evidence schedule.

Stage	Control	Evidence	Stop condition
Mobilisation	Access, zoning, temporary services and briefings	Approved construction-security plan	Uncontrolled access or undefined vulnerable zones
Delivery	Expected consignment, custody and inspection	Delivery and material identity record	Damage, route anomaly or unverified substitution
Installation	Observation of vulnerable and concealed work	Hold-point record and photographs	Work proceeds before required observation

Stage	Control	Evidence	Stop condition
Closure	Authorised release of concealed work	Signed release and nonconformance status	Open defect or missing evidence
Final inspection	Baseline comparison and technical inspection	Final record and disposition	Unresolved anomaly or uncontrolled change

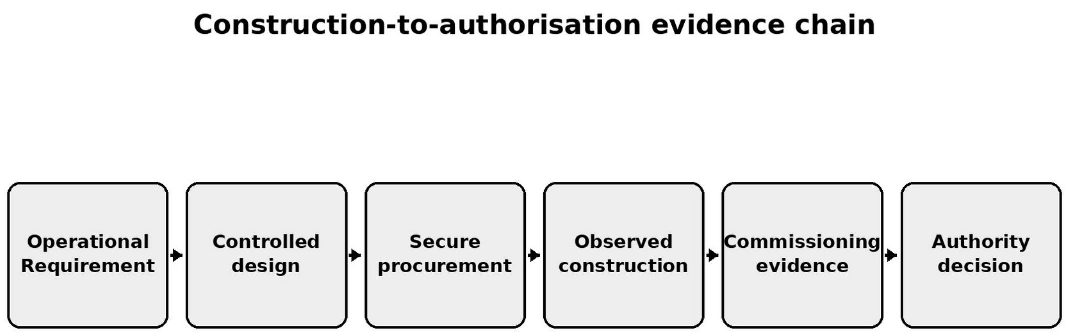

Figure 30-4. Construction-to-authorisation evidence chain for a secure-speech environment. Author original diagram.

Worked example 30.19. Concealed-work observation coverage

A project defines 180 concealed-work hold points. One hundred and seventy-two are observed before closure, five are recovered by authorised local opening and three remain unresolved. Let C_h be evidenced hold-point coverage.

The evidenced coverage is 98.3 per cent. The three unresolved hold points require formal disposition and may justify further opening or restriction.

The ratio treats each hold point equally. A single missed critical interface can outweigh many routine observations.

30.29 Procurement, logistics, material identity, and supply-chain assurance

Secure construction depends upon authentic materials, controlled configuration and traceable custody. Procurement should specify exact performance, model, revision, approved alternatives, documentation, inspection rights, secure delivery, storage and change notification. Lowest initial cost can be false economy when a substitution cannot be verified after installation or when its geometry alters a tested door, wall, seal or electronic-security interface. [213]

UK NACE public construction-security material describes inspection of materials and deliveries commensurate with risk. The supply-chain plan should therefore map manufacturer, distributor, transporter, storage, site receipt, quarantine, inspection and release. Serial numbers, batch numbers, certificates, photographs and tamper indicators support identity. Packaging damage, unexpected route changes or undocumented rework require disposition before material enters a protected zone.

Procurement also governs software, firmware and remote services. A physical product can change function through update or licence. Contract clauses should require vulnerability notification, support periods, configuration records, secure disposal and access to necessary evidence. Supplier assurance supports project control but does not transfer the authority's acceptance decision to the vendor.

Supply-chain anomalies require a predetermined quarantine and escalation process; unexpected routing, damaged packaging, serial-number mismatch,

213 MB-0998. Joint Committee for Guides in Metrology, JCGM GUM-1:2023 and JCGM GUM-6:2020, 2023 and 2020. Status at the 14 August 2026 source freeze: Published and current at source freeze. Public locator: Use is confined to the source scope. The docume.

substituted materials, unexplained firmware, altered seals or incomplete custody records should be treated according to consequence, not normalised as administrative inconvenience; the project should preserve the item and associated records until an authorised disposition is made. Acceptance testing after installation cannot always reveal provenance compromise; identity and custody evidence therefore complement performance evidence, especially for components that become inaccessible or trusted within the final configuration.

Worked example 30.20. Supply-chain traceability coverage

A controlled bill of materials contains 96 line items. Eighty-nine have manufacturer, model, batch or serial evidence, custody record and installation location. Let C_t be traceability coverage.

Traceability coverage is 92.7 per cent. Seven items require reconciliation before they are concealed or relied upon in acceptance.

The ratio does not prove authenticity or absence of tampering. Evidence quality, inspection depth and supplier risk remain separate considerations.

30.30 Security-minded information management and controlled digital records

Drawings, models, photographs, access routes, equipment schedules, acoustic traces and defect maps can reveal vulnerabilities when combined. NPSA's security-minded information-management guidance recognises that information supports effective delivery while also creating risk if lost, altered or disclosed. The project must therefore protect information without starving designers, inspectors and maintainers of the evidence needed to do competent work. [214]

The information plan should classify content, not merely documents; it should define authorship, approval, metadata, access, transmission, redaction, aggregation, retention, disposal and release; digital models need role-based views and controlled exports; photographs require location and purpose, but public copies may need cropping or abstraction. Test data should retain raw files and processing history while separating sensitive location information from general technical learning.

A controlled record must remain usable. Excessive restriction can produce private spreadsheets and untraceable messaging, while indiscriminate sharing can expose the facility. The plan should support authorised collaboration, audit and handover. At project close, the asset owner needs a maintained baseline, not a sealed archive that nobody can interpret during the first urgent repair.

Digital information models can expose security-sensitive relationships even when individual objects appear innocuous; combined geometry may reveal protected room locations, barrier build-ups, service routes, access controls, sensor positions or maintenance pathways; the information-management plan should define purpose, minimum necessary detail, classification, access, export, federation, redaction, retention and disposal. Revision history and checksums support integrity, while role-based access and controlled exchange support confidentiality; a convenient common data

214 MB-0007. Acoustic Security Engineering for Secure Rooms, Revision 1.2C2, Chapters 1 through 34 cumulative treatment.

environment is not automatically an authorised repository for every security dataset.

Worked example 30.21. Aggregation sensitivity score

Five data sets receive project sensitivity weights 2, 3, 4, 2 and 5. Their individual access probabilities are 0.10, 0.05, 0.04, 0.15 and 0.02. Let I_d be the weighted exposure sum.

The screening exposure sum is 0.91 weighted units. The fourth data set contributes most because of its higher access probability despite modest individual sensitivity.

The calculation does not capture aggregation effects, hostile intent, data correlation or legal classification. It is a prioritisation aid only.

30.31 Mock-ups, first-of-type installations, hold points, and nonconformance

A first-of-type installation converts drawings into observed workmanship before repetition multiplies defects. It should include representative junctions, services, seals, hardware, fire-stopping, finishes and access conditions. The review tests buildability, tolerances, inspection access, sequence, material identity and evidence capture. Approval of a sample does not excuse later inspection; it establishes the benchmark against which repeated work is compared. [215]

Hold points should be specific and observable. Phrases such as inspect wall before closure are inadequate. The schedule should identify location, stage, drawing, acceptance feature, required witness, evidence and release authority. Nonconformance records should state fact, requirement, cause,

215 MB-1315. Whole Building Design Guide, Public building commissioning resources and current UFGS master.

proposed disposition, technical effects, temporary controls, retest and final authority. A cosmetic repair is not closure when the hidden mechanism remains uncertain.

Statistical sampling can support repetitive work after the process is demonstrated and stable, but it cannot justify skipping unique or critical interfaces. Defect trends should feed back to training and inspection frequency. Repeated minor discrepancies may reveal a systemic process failure. The release decision should preserve residual uncertainty and prevent conditional work from being silently incorporated into the authorised baseline.

A first-of-type installation should test the whole method, including materials, sequencing, tolerances, access, inspection, interfaces and evidence capture; approval of the sample applies only within the recorded configuration; if later work changes board type, stud depth, sealant, sleeve, fixing, installer method or surrounding substrate, equivalence must be demonstrated rather than presumed. Nonconformance trends should be reviewed statistically and causally; repeated minor defects may indicate a systemic process failure even when each individual defect appears locally repairable.

Table 30-10. First-of-type and nonconformance decision matrix.

Condition	Immediate action	Evidence required	Possible disposition
First-of-type mismatch	Pause repetition and identify cause	Dimension, material and sequence records	Revise detail, method or training
Missed hold point	Protect area and notify authority	Alternative examination plan	Local opening, test, restriction or rebuild
Unapproved substitution	Quarantine or isolate affected work	Identity and performance comparison	Reject, approve formally or remove
Repeated minor defect	Increase inspection and review process	Trend and causal analysis	Process correction and expanded sampling
Critical concealed uncertainty	Stop dependent work	Authorised destructive or non-destructive evidence	Reconstruct or accept bounded residual risk

Worked example 30.22. First-of-type defect reduction

A first-of-type installation reveals 14 defects. Process correction reduces the next five installations to 3, 2, 2, 1 and 2 defects. Let r be the mean defect-reduction fraction relative to the first installation.

The mean defect count falls by 85.7 per cent. The result supports process improvement but still requires verification of each critical interface.

The comparison assumes equivalent installation complexity and consistent inspection depth. Fewer recorded defects can also result from weaker observation.

30.32 Measurement planning, instrumentation, calibration, and source stability

Measurement begins with the proposition to be tested. The plan should state source, receiver, room state, frequency range, positions, duration, background, instrument class, calibration, environmental conditions, uncertainty, decision rule and reporting boundary. A collection of spectra without a defined decision question is technically interesting but procedurally weak. [216]

The instrumentation chain includes source, amplifier, loudspeaker, microphone, preamplifier, digitiser, analyser, software and timing. Calibration before and after a test detects gross drift, but it does not establish full frequency response, phase match or self-noise. Certificates, serial numbers, settings, firmware and processing scripts should be retained. Multi-channel work needs synchronisation and channel-specific checks.

216 MB-0804. International Electrotechnical Commission, IEC 61672-1:2013.

Source stability is crucial for comparing positions or interventions. Changes in loudspeaker temperature, limiting, battery condition or room loading can mimic path changes. A reference microphone or repeated reference position can reveal drift. The plan should define stop conditions and retest rules before results are seen, rather than selecting a convenient explanation after an unfavourable measurement.

The measurement chain should be traceable from acoustic source to reported result; the plan should record source spectrum and stability, microphone and accelerometer calibration, channel sensitivity, analyser settings, bandwidth, averaging, environmental conditions, position coordinates and data-reduction software. Pre-test and post-test checks help detect drift, but they do not replace full calibration; dynamic range and background should be examined band by band; raw files, calibration records and scripts should be retained so that a later reviewer can reconstruct the calculation.

Worked example 30.23. Calibration drift correction

A field calibrator produces 94.0 dB before testing and 93.4 dB afterwards. Let delta_c be observed drift and L_corr the corrected measured level if a linear half-drift correction is authorised.

The observed drift is negative 0.6 dB, suggesting a 0.3 dB midpoint correction under the stated assumption. The uncertainty budget should also include residual drift.

A midpoint correction is not automatically required by every method. Drift may reflect coupling, environment or equipment fault and can instead trigger invalidation or retest.

30.33 Field sound isolation, speech-security assessment, and leakage localisation

Field sound-isolation measurement quantifies an installed room relationship under stated conditions. ISO 16283-1 provides a public consensus framework for airborne sound insulation. Secure-speech assessment adds source-state, receiving background, listener access and institutional decision rules. Neither a laboratory rating nor a field single number automatically proves that words cannot be recovered outside the room. [217]

Diagnostic work should compare room-average quantities with local scans, door and plant states, temporary seals, source relocation, intensity or proximity measurements, vibration sensors and controlled interventions. A local improvement after sealing supports a path hypothesis. It does not prove that the permanent repair will behave identically or that other paths are absent. Every intervention should be reversible where possible and recorded.

Reports should separate measured fact, processing, analytical inference, functional speech conclusion and authority decision. They should preserve spectra, source stability, positions, backgrounds, room condition, calibration and raw data. Untested zones, languages, listener populations, operating states and technical-attack modes remain explicit limitations.

Field isolation and speech-security assessment answer different questions; a room-to-room level difference characterises an installed relationship under specified conditions; a listener-related method introduces source, background, language, access and perception assumptions; leakage localisation ranks possible paths but may not quantify total privacy. The

217 MB-0806. International Electrotechnical Commission, IEC 61672-2:2013.

report should therefore state the measurand, test state, receiver geometry, uncertainty and inferential boundary. No public acoustic test, by itself, should be described as granting UK NACE approval or authority for classified discussion.

Worked example 30.24. Band speech-to-background margin

At a receiving position, residual speech levels in the 500, 1000 and 2000 hertz bands are 30, 27 and 23 dB. Background levels are 28, 25 and 22 dB. Let M_i be the band margin.

The residual speech exceeds background by 1 to 2 dB in the three bands. The margins support further intelligibility analysis and path diagnosis.

The calculation does not establish word recovery, because modulation, listener ability, room response, duration and other bands are omitted.

30.34 Measurement uncertainty, guard bands, and decision rules

An acceptance statement is incomplete without uncertainty and a decision rule. ISO 12999-1 and JCGM guidance provide public frameworks for uncertainty and conformity assessment. Contributors can include calibration, source stability, spatial sampling, temporal variation, background correction, reverberation, processing, repeatability and model assumptions. Correlation must be considered rather than adding every term as though independent. [218]

The project should define the measurand, probability convention, coverage factor, limit, guard band and treatment of conditional results before testing. A value on the favourable side of a limit can still have substantial probability

218 MB-0803. International Electrotechnical Commission, IEC 61260.

of nonconformity. Conversely, excessive guard bands can reject capable work without a risk rationale. The competent authority owns the acceptance consequence, while the laboratory explains the measurement evidence.

Uncertainty also attaches to forensic attribution and source-state inference. A precise instrument reading does not remove uncertainty about an unobserved construction condition or a changing operating state. Reports should distinguish quantified measurement uncertainty from broader epistemic uncertainty and should state what additional observation would materially improve the decision.

An uncertainty budget should include instrument calibration, source repeatability, spatial sampling, temporal variation, background correction, environmental influence, position reproducibility and data processing; correlated components should not be combined as though independent; the acceptance rule should identify the protected decision, tolerable false-acceptance risk, guard band and authority for exceptions. A reported margin smaller than expanded uncertainty is weak evidence; conversely, a conservative guard band cannot compensate for an omitted path or an unrepresentative operating state.

Worked example 30.25. Combined standard uncertainty and guard band

Independent standard uncertainty components are 0.7, 0.9, 0.5 and 0.6 dB. Let u_c be the root-sum-square combined standard uncertainty and U the expanded uncertainty for k = 2.

The expanded uncertainty is approximately 2.8 dB. A decision rule may apply a guard band related to consequence and accepted risk.

The calculation assumes independence, normal behaviour and correctly estimated components. Correlation or unmodelled state variation can increase uncertainty.

30.35 Commissioning, UK NACE testing, acceptance, and authority to use

Commissioning demonstrates that the installed system performs under the defined states and that the supporting evidence is coherent. FCDO Services publicly states that UK NACE teams assess secure conference-room performance after construction. This public description does not disclose the controlled criteria, threshold or decision process, and it should not be reverse-engineered from product claims. [219]

The commissioning matrix should cover enclosure, doors, glazing, HVAC, services, audiovisual systems, masking, monitoring, access control, emergency modes, maintenance states and source conditions. It should identify method, equipment, uncertainty, witness, expected result, raw-data location and decision owner. Defects must remain linked to restrictions, retest and closure evidence.

Acceptance is not one event. Technical completion, contractual completion, building-control compliance, physical-security acceptance, technical-security assessment and authority to conduct a defined sensitive activity can be different decisions. Handover should identify which decisions are complete, conditional, expired or outside scope. No marketing phrase should convert a component test into general government approval.

219 MB-0862. International Organization for Standardization, ISO 16063-21:2003.

Commissioning should close four distinct questions: whether the specified system was installed, whether contractual deliverables were met, whether statutory obligations are satisfied, and whether the responsible security authority permits the intended use. One evidence package may support several questions, but the decisions and signatories remain different. The matrix should include open defects, concessions, operating conditions, expiry or review dates and dependencies upon monitoring or procedure. Occupancy pressure must not convert provisional engineering evidence into an implied authority decision.

Table 30-11. Commissioning and authorisation matrix.

Decision layer	Question	Evidence	Decision owner
Technical completion	Was the specified system installed and tested?	Inspection, calibration and test records	Project and technical leads
Contractual acceptance	Were contract deliverables met?	Completion records and defect status	Contracting authority
Building compliance	Are statutory duties satisfied?	Applicable approvals and safety information	Relevant statutory dutyholders
Technical-security assessment	Does the configured environment meet the authorised technical proposition?	Controlled assessment record	Applicable technical-security authority
Authority to use	May the intended sensitive activity occur under stated conditions?	Complete assurance package and conditions	Responsible governmental authority

Worked example 30.26. Commissioning-state closure

A commissioning matrix contains 72 required state tests. Sixty-six pass, four pass conditionally with authorised restrictions and two remain open. Let C_c be closed-state coverage including authorised conditional closure.

Closed-state coverage is 97.2 per cent. The two open states prevent unconditional release unless the authority excludes those states from permitted use.

The ratio weights all states equally and does not establish whether a conditional result is acceptable for the intended classification or mission.

30.36 Monitoring, defensive baselines, anomaly response, and mobile operations

UK NACE publicly describes live monitoring, in-place monitoring systems, RF propagation surveys and TEMPEST monitoring for sensitive environments. Monitoring supplements, rather than replaces, sound construction, disciplined operation and periodic inspection. Its purpose, coverage, alert thresholds, retention, legal basis and response chain must be defined. A silent system with no tested response is not assurance. [220]

The baseline should characterise expected acoustic, RF, equipment and environmental states where authorised. Changes can arise from legitimate maintenance, neighbouring transmitters, new devices, software updates or hostile activity. Automated alerts require human interpretation and correlation with access, work orders and room use. The system should record its own health, calibration, outages and configuration changes.

Monitoring for mobile or temporary use requires special caution because geometry, networks, power, access and neighbouring conditions change. A baseline from one venue cannot be carried to another like a monogrammed travelling case. Pre-use survey, controlled setup, live observation, incident response and post-use reconciliation should match the consequence and authority.

Monitoring systems require their own assurance case; sensors, baselines, thresholds, communications, storage, maintenance and response

220 MB-0804. International Electrotechnical Commission, IEC 61672-1:2013.

procedures can fail or generate misleading alerts; normal seasonal or operational variation should be characterised to reduce false positives, while the system must remain sensitive to consequential change. An alarm should lead to triage, preservation and authorised investigation, not automatic attribution; mobile or temporary operations need particular care because geometry, services and adjacent access can change faster than a permanent facility's controlled baseline.

Worked example 30.27. Monitoring coverage fraction

A monitoring design identifies 28 consequential channels or zones. Twenty-four are continuously observed, two are sampled periodically and two are unobserved. Assign coverage factors 1.0, 0.4 and 0. Let C_m be weighted coverage.

Weighted monitoring coverage is 88.6 per cent. The unobserved zones and intermittent channels require explicit residual-risk treatment.

The factors are planning assumptions and do not represent detection probability, sensor quality, adversary behaviour or response effectiveness.

30.37 Maintenance, configuration control, and minor works

Secure-room performance drifts through ordinary work. A replaced door closer, new cable, adjusted diffuser, relocated camera, patched controller or repainting at a seal can be technically consequential despite modest cost. Maintenance classification should therefore depend on mechanism and boundary effect, not financial value or the confidence of the person carrying the toolbox. [221]

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221 MB-0803. International Electrotechnical Commission, IEC 61260.

The work-order process should screen location, system, boundary crossing, escort, evidence, approved method, parts, settings, before-and-after state, testing and authority notification. Standard procedures are valuable for recurring work, but they must define the exact eligible configuration and stop conditions. Removed parts and unexplained anomalies may require preservation.

Trend analysis can reveal recurring causes such as seal wear, cable growth, access-panel damage, filter-induced pressure shifts or firmware drift. Maintenance records should update the configuration baseline and recommissioning schedule. Where emergency repairs occur, temporary restrictions and a time-bound recovery plan prevent the exception from becoming the permanent, undocumented state.

Maintenance control should distinguish like-for-like replacement from consequential change; even apparently identical seals, ceiling tiles, filters, door hardware, cables or software versions can alter performance or evidence; work orders should identify the protected boundary, approved method, authorised personnel, access conditions, photographs, tests and restoration status. Emergency repairs require temporary controls and later formal closure; a maintenance management system that records only labour and cost is insufficient where the task affects a secure-speech configuration or its technical-security dependencies.

Worked example 30.28. Configuration-drift rate

A quarterly audit examines 120 controlled configuration items and finds 9 undocumented deviations. Let r_d be the observed drift rate.

The observed drift rate is 7.5 per cent. Repeated audits can test whether maintenance controls reduce the rate and whether deviations cluster by system or contractor.

The rate does not measure security consequence. One critical deviation can outweigh several minor documentary discrepancies.

30.38 Incident response, evidence preservation, and forensic examination

An acoustic or technical-security incident can present as overheard speech, unexplained signal, changed background, damaged seal, disturbed fitting, new penetration or suspicious object. The first response should protect people and information, preserve the scene, record time and state, and notify the authorised security chain. Users should not investigate casually or discuss suspicions within the potentially compromised space. [222]

Evidence can include photographs, access records, work orders, control logs, raw acoustic or RF data, calibration, witness accounts, removed components and environmental conditions. The sequence of interventions matters because opening a wall, resetting a controller or moving a device can erase transient evidence. Chain of custody should match consequence and potential legal use.

Analysis should distinguish fact, measurement, hypothesis, excluded alternative, unresolved possibility and residual risk. A discovered vulnerability does not prove exploitation. Failure to prove exploitation does not automatically justify renewed sensitive use. Restoration, technical

222 MB-0908. International Organization for Standardization, ISO 9614-1:1993.

clearance and authority to resume operations are separate decisions, and the incident record should state each one.

A suspected incident should be managed as both a security event and an evidentiary scene; immediate priorities include protecting people, stopping further exposure where authorised, controlling access, preserving system states, preventing well-intentioned disturbance and notifying the correct authority. Investigators should separate observation, measurement, inference and attribution; acoustic testing, TSCM, digital forensics, physical examination and interviews may need coordinated sequencing; remediation should not destroy the evidence required to understand cause, scope, duration or recurrence risk.

Worked example 30.29. Incident-timeline completeness

An incident record identifies 22 consequential events. Nineteen have verified time, actor, action and evidence reference. Let C_e be timeline completeness.

Timeline completeness is 86.4 per cent. Three events require reconciliation, and causal conclusions should acknowledge the gaps.

The ratio does not assess the truth of witness accounts, clock synchronisation or whether unrecorded events occurred.

30.39 Change control, recommissioning triggers, and continuing assurance

A secure-speech authorisation is attached to a configuration and use, not to a postal address. Changes in tenancy, source level, glazing, doors, HVAC, communications, monitoring, furniture, background, access or adjoining construction can alter the conclusion. The change-control process should screen every proposal against the protected function and the complete path model. [223]

Triggers can be scheduled or event driven. Examples include structural work, new penetrations, door replacement, major maintenance, firmware change, incident, unexplained trend, change of classification, new neighbouring tenant or extended operating hours. The response can range from document review and local inspection to partial or full recommissioning. The rationale and authority should be recorded.

Continuing assurance combines user checks, technical inspection, monitoring, maintenance evidence, periodic tests and governance review. It should remain proportionate and capable of detecting slow degradation. A room that passed once but has no controlled lifecycle is a historical artefact, not a dependable security capability.

Recommissioning triggers should be explicit and proportionate; typical triggers include penetration work, door replacement, glazing repair, HVAC rebalance, masking changes, audiovisual updates, adjacent tenancy alteration, structural movement, water damage, prolonged outage, incident investigation or classification change; the change register should map each event to affected assumptions and evidence. Some changes require inspection only, others targeted measurements, and the most consequential require a full authority review; calendar-based testing alone cannot capture every material change.

223 MB-0909. International Organization for Standardization, ISO 9614-2.

Table 30-12. Change trigger and proportionate recommissioning matrix.

Trigger	Affected assumptions	Minimum response	Escalation condition
New penetration or cable route	Envelope continuity, fire stopping and path register	Inspect work and update penetration record	Unknown concealed condition or failed local test
Door, glazing or seal replacement	Tested configuration and operating geometry	Verify identity, installation and functional state	Material difference, poor fit or uncertain equivalence
HVAC rebalance or plant alteration	Duct path, pressure state and background spectrum	Record state and perform targeted acoustic checks	Changed security margin or new accessible path
Audiovisual or network update	Source state, connected functions and configuration baseline	Review hardware, firmware, interfaces and operating modes	New microphone, radio, remote access or diagnostic capability
Incident, damage or adjacent works	Threat, access, structure and evidence integrity	Preserve evidence and commission scoped reassessment	Potential compromise, uncontrolled opening or uncertain duration

Worked example 30.30. Recommissioning trigger score

A change is scored across five project-defined factors: boundary effect 4, source-state effect 3, technical-system effect 4, access effect 2 and evidence uncertainty 3. Let S_t be the summed screening score.

The screening score is 16 units. Under a project rule that scores of 12 or more require formal recommissioning review, the change crosses the review threshold.

The factors and threshold are project tools, not United Kingdom government criteria. The competent authority determines the actual response.

30.40 Training, security culture, meeting discipline, and user behaviour

Technical construction cannot compensate for persistent poor behaviour. Users decide where they speak, how loudly they speak, whether doors remain closed, whether unauthorised devices enter, and whether faults are reported. Security training should explain the reason for controls without disclosing unnecessary vulnerabilities. Rehearsed procedures are more reliable than signs that fade into the wallpaper. [224]

The operating procedure should address room booking, access, visitors, mobile devices, conferencing, displays, interpreters, cleaning, maintenance, emergency interruption, equipment failure, after-hours use and incident reporting. Meeting chairs need authority to pause or relocate a discussion when a control fails. Staff should know that masking, monitoring or a green indicator does not remove the need for disciplined behaviour.

Training should be role-specific and refreshed after material change. Observation, exercises and incident trends provide better evidence than attendance alone. Repeated door propping or unreported faults can indicate that the operational design is impractical. The remedy may require physical redesign as well as instruction. Security culture is strongest when procedures fit the work and management responds visibly to defects.

Training should be role specific and observable in practice; occupants need meeting discipline, fault reporting and prohibited-state awareness; facilities staff need boundary identification, work controls and escalation; security personnel need authority limits and evidence requirements. Contractors need access, custody and stop-work rules. Exercises should include door faults, masking loss, unexpected maintenance and suspected surveillance. Repeated behavioural deviations indicate a system-design problem as well as a training problem, because controls that depend upon constant exceptional vigilance are fragile.

224 MB-0894. International Organization for Standardization, ISO 5348:2021.

Worked example 30.31. Behavioural-control compliance

During 50 observed meeting starts, the required device check, door check and fault-status check are all completed in 44 cases. Let C_b be complete behavioural-control compliance.

Complete start-of-meeting compliance is 88 per cent. The six failures should be analysed by cause rather than treated as isolated lapses.

Observation can alter behaviour, and the ratio does not measure whether each check was performed competently or whether other unsafe practices occurred.

30.41 Accessibility, fire, safety, and security trade-offs

Secure spaces remain workplaces and buildings. Fire safety, means of escape, accessibility, structural safety, ventilation, welfare and maintainability continue to apply. A security measure that obstructs egress, creates excessive door force, removes necessary alarms or excludes disabled users is not an acceptable solution merely because it appears protective. [225]

Coordination should begin early. Door mass and seals affect opening force, closer selection and automatic operators. Lobbies affect circulation and evacuation. Acoustic treatments can affect fire classification and detector response. Masking can affect alarm audibility. Restricted controls can affect assistive technology. Applicable jurisdiction must be confirmed because building regulation differs across the United Kingdom.

The design record should identify each trade-off, responsible specialist, evidence and final decision. Where a control cannot meet every objective

225 MB-0237. ASTM International, ASTM E2638-24.

simultaneously, the team should redesign the system rather than asking one discipline to waive another informally. Emergency states should be tested because fail-safe changes can expose speech or disable ordinary controls. The authorised use procedure should recognise those temporary conditions.

Security measures must be reconciled with fire, accessibility, structural and workplace duties through competent design, not by treating safety as an exception; door force, escape hardware, alarms, refuge communications, ventilation, lighting and accessible controls may affect acoustic or technical-security performance. The design should document the conflict, relevant dutyholders, selected solution, testing and residual conditions; an acoustic improvement that obstructs escape or excludes disabled users is not acceptable; equally, late safety alterations should not bypass security change control.

Worked example 30.32. Door-force operating margin

An accessible door operator is designed for a maximum project opening force of 30 newtons. Measurement gives 24 newtons with standard uncertainty 2 newtons. Let M_f be the nominal margin and M_g the conservative margin using two standard uncertainties.

The nominal margin is 6 newtons and the conservative margin is 2 newtons. Wear, seal adjustment and temperature should be considered before acceptance.

The project value is illustrative and is not a substitute for the applicable statutory guidance, test method or accessibility assessment.

30.42 Private-sector adoption without false governmental equivalence

Commercial organisations, barristers' chambers, research laboratories and corporate boards can apply public UK protective-security principles to privileged or sensitive discussions. They can define threats, control adjacency, use robust construction, manage information, test field performance and maintain the room. These measures can materially improve protection without claiming governmental status. [226]

The private authority chain should identify the risk owner, accepting executive, legal adviser, facilities lead, cyber authority, technical-security specialist and independent tester. Specifications should state the intended function, measurable criteria, source states, accessible receiving zones, uncertainty and lifecycle controls. Marketing terms such as government secure, NPSA approved or UK NACE compliant should not be used without a precise and supportable basis.

A private acceptance decision remains bounded to the organisation's threat model and use. It does not authorise UK government classified discussion, confer a security classification, or replace competent-authority criteria. The report should say what was measured and under which conditions. Precision is more valuable than theatrical language, particularly when the document may later be read in litigation or by an insurer.

Private organisations may adopt the same disciplined methods without claiming governmental status; they can define an Operational Requirement, control sources, manage construction evidence, test whole-room performance and maintain configuration; they cannot represent a room as

226 MB-0817. International Organization for Standardization, ISO 10140-4:2021.

UK NACE approved, government accredited or suitable for a classified use without the actual authority and applicable process. Marketing language should distinguish public guidance, contractual targets, independent testing and governmental decisions; this precision protects clients from false assurance and preserves the meaning of official terminology.

Worked example 30.33. Claim-precision rate

A marketing and technical package contains 32 performance claims. Twenty-eight identify configuration, condition, method and limitation. Let C_p be claim-precision rate.

The claim-precision rate is 87.5 per cent. Four unbounded claims should be corrected before issue.

The ratio does not establish technical truth or legal sufficiency. Each claim still requires competent evidence and appropriate review.

30.43 Contracts, Security Aspects Letters, supplier obligations, and national-security procurement

Government and defence contracts require explicit security obligations. The MOD publicly describes Security Aspects Letters as a contractual means of defining classified aspects and obligations. PPN 012 extends current classification policy into in-scope contracts. PPN 025 addresses national-security considerations in public procurement. These instruments govern different decisions and should be applied by the appropriate contracting and security authorities. [227]

The contract should translate the approved security approach into deliverables, access conditions, personnel requirements, information

227 MB-0217. ASTM International, ASTM E1573-22.

handling, subcontracting, incident reporting, supply-chain controls, inspection rights, configuration records, secure logistics, support, disposal and remedies. Technical specifications should avoid disclosing protected vulnerabilities to bidders who do not need them. Staged release and security-minded tender information can preserve competition while controlling exposure.

Contract compliance is not the same as facility authorisation. A supplier can meet its contractual tasks while the project remains unapproved because evidence is incomplete or conditions have changed. Conversely, an authority should not rely on a vague contract to create technical obligations after award. Security, commercial and engineering records must align before acceptance and payment.

Contract documents should translate the security requirement into enforceable responsibilities without reproducing protected criteria unnecessarily; the Security Aspects Letter or equivalent instruction should align with specifications, drawings, access rules, information handling, supply-chain obligations, incident reporting, evidence delivery and subcontractor flow-down. Tender evaluation should examine competence and security capability, not only price; variations require security review before instruction; at completion, the authority should receive the records needed to operate, maintain, investigate and recommission the configured environment.

Worked example 30.34. Contract-security obligation coverage

A contract-security schedule contains 44 required obligations. Forty-one appear in enforceable clauses with owners, evidence and remedies. Let C_o be obligation coverage.

Contract-security obligation coverage is 93.2 per cent. Three requirements remain advisory or unowned and should be resolved before award.

The ratio does not determine legal enforceability or whether the clauses are proportionate, lawful or technically adequate. Solicitor and security-authority review remain necessary.

30.44 Comparative method, public-source limits, and controlled-document boundaries

Comparative scholarship should map function, authority, evidence and decision rather than matching labels. A secure working area is not automatically a SCIF. A secure speech environment is not automatically a TCR or Canadian specialised security zone. Similar engineering mechanisms can operate beneath different legal, institutional and classified frameworks. [228]

Public sources permit careful description of organisations, high-level functions, terminology, risk principles and disclosed services; they do not justify reconstruction of protected thresholds, inspection techniques, attack assumptions or facility-specific vulnerabilities; an official service page is not a full standard. A procurement notice is not a design manual; historical material can explain development but should not control current practice without verified status.

228 MB-0798. International Electrotechnical Commission, IEC 60268-16:2020.

The crosswalk should record exact equivalence, bounded similarity, non-equivalence and unknown or controlled content. Every conclusion should identify its source date and limitation. Where evidence ends, the text should stop. This discipline protects both scholarship and security, and it prevents a plausible synthesis from becoming a counterfeit authority.

Comparative crosswalks should map function, authority, evidence and decision effect rather than force vocabulary into one-to-one equivalence; a United Kingdom secure speech room is not automatically the same institutional object as an American SCIF, a Canadian secure room or a commercial privacy room. Similar acoustic methods may be useful across them, but accreditation, classification, adjoining-space assumptions and technical-security authority differ; unknown or controlled elements should remain marked as such; honest non-equivalence is more useful than a neat but misleading table.

Worked example 30.35. Crosswalk classification completeness

A comparative matrix contains 50 topic rows. Twelve are exact functional matches, 21 are bounded similarities, 9 are non-equivalent and 8 remain controlled or unknown. Let C_x be the classified-row fraction.

All rows have an explicit disposition, although 16 per cent remain controlled or unknown. The matrix is complete as a classification exercise, not as a disclosure of hidden criteria.

Complete categorisation does not prove that the categories are correct. New authority guidance or protected information can require revision.

30.45 Lifecycle synthesis and final United Kingdom doctrine

The public United Kingdom doctrine is a chain. Define the protected function and risk. Select the correct institutional concept. Locate the space to reduce vulnerability. Integrate physical, personnel, information, cyber and technical security. Control design information, procurement, logistics and construction. Test the installed configuration. Authorise the defined use. Monitor, maintain, investigate change and recommission when required. [229]

The weakest-path principle applies across this chain. A strong wall cannot compensate for an uncontrolled door, a disciplined meeting cannot cure an accessible duct, and a technical inspection cannot repair defective governance. Conversely, no single protective measure proves comprehensive security. Assurance emerges from coherent authority, mechanism-specific evidence and continuing control.

Public NPSA, NCSC, Cabinet Office and FCDO Services material supports this high-level synthesis while preserving the boundary around controlled criteria. The final report should identify what the public evidence establishes, what competent authorities supplied separately, what was measured, what remains uncertain and which changes invalidate the conclusion. Chapter 31 can then examine Canadian practice without treating the institutions of the Commonwealth as though they were interchangeable departments of one imagined empire.

The final assurance case should be readable as a chronological chain from authorised need to continuing operation; it should identify the source freeze, controlled baselines, threat and access assumptions, design

229 MB-0804. International Electrotechnical Commission, IEC 61672-1:2013.

responses, construction evidence, measurements, uncertainties, defects, decisions, operating conditions, monitoring and change triggers. Each conclusion should name its scope and owner; the case remains open to revision when evidence or conditions change; this discipline prevents the polished final report from becoming a static ceremonial artefact detached from the room it purports to describe.

Figure 30-5. Lifecycle assurance loop for a United Kingdom secure-speech environment. Author original diagram.

Worked example 30.36. Lifecycle assurance closure ratio

A lifecycle register contains 80 required controls across definition, design, construction, testing, operation and change. Seventy-six are closed with evidence. Let C_l be lifecycle closure.

Lifecycle assurance closure is 95 per cent. Four open controls remain visible and prevent an unqualified completion claim.

The ratio weights controls equally and does not establish governmental authorisation. Criticality, evidence quality and protected criteria remain authority matters.

Chapter 30 establishes that United Kingdom public secure-speech doctrine is a governed lifecycle rather than a product label. Cabinet Office policy, NPSA protective-security guidance, NCSC cyber and electromagnetic-security responsibilities, and UK NACE technical-security authority meet at controlled interfaces while retaining distinct remits. [230]

Acoustic engineering contributes through source-state definition, complete-envelope design, room acoustics, construction observation, field measurement, uncertainty, maintenance and change control. It does not

230 MB-0806. International Electrotechnical Commission, IEC 61672-2:2013.

issue classification, physical-security approval, cyber authorisation, TEMPEST certification, TSCM clearance or authority for sensitive governmental use.

Chapter 31 now examines Canadian federal physical security, acoustic security, EMSEC and secure-facility doctrine while preserving Canadian institutional vocabulary and the boundary between public guidance and protected technical criteria.

Chapter 30 Glossary

NACE. United Kingdom National Authority for Counter-Eavesdropping.

NCSC. United Kingdom National Cyber Security Centre.

NPSA. National Protective Security Authority.

Secure room. United Kingdom public protective-security concept whose exact meaning follows the controlling source.

Secure speech environment. Protected speech setting assessed under the applicable United Kingdom authority and conditions.

Secure working area. Broader controlled working environment described in NPSA public guidance.

Security-minded information management. Control of project information according to its sensitivity, need and lifecycle.

TEMPEST. Technical-security discipline concerning compromising emanations under the applicable authority.

Accreditation or authorisation. Decision by the responsible authority that a defined facility or use may proceed under stated conditions.

Departmental Security Adviser. Departmental role providing security leadership and advice under the applicable government governance structure.

Electromagnetic Security. Management of risk from electromagnetic phenomena that may expose sensitive information.

Government Security Classifications Policy. Administrative framework using OFFICIAL, SECRET and TOP SECRET classifications for United Kingdom government information.

GovS 007. Government Functional Standard setting high-level expectations for security governance and management.

Guard band. Decision margin applied between a measured result and an acceptance limit to control conformity risk.

In-place monitoring system. Technical monitoring capability installed to support continuing awareness of a defined environment.

Listener-access geometry. Spatial and temporal description of positions from which unauthorised observation or listening may be credible.

Maximum vocal effort. Demanding authorised speech source state used in public FCDO Services descriptions, without disclosure of controlled thresholds.

NCSC. National Cyber Security Centre, the United Kingdom national technical authority for cyber security and electromagnetic security.

NPSA. National Protective Security Authority, the United Kingdom national technical authority for protective security.

Operational Requirement. NPSA process for defining security needs from assets, threats, risks and operational conditions before selecting measures.

Protected space. Space selected or designed for enhanced protection against specified hazards, distinct from secure rooms and secure working areas.

Security Aspects Letter. Contractual instrument used in United Kingdom defence contracting to define classified aspects and associated security obligations.

Security-minded information management. Proportionate control of information according to sensitivity, need, integrity and lifecycle.

Secure room. NPSA public concept used principally for storage of sensitive information or large assets.

Secure speech environment. Protected environment for sensitive discussion under the applicable authority, conditions and technical-security arrangements.

Secure working area. NPSA public concept for an area where personnel work with sensitive information or assets.

Source freeze. Documented date at which the status and public accessibility of sources are captured for a release.

Technical Surveillance Countermeasures. Specialist examination and mitigation of technical-surveillance vulnerabilities and devices within a defined scope.

TEMPEST. Investigation and management of compromising electromagnetic emanations under the applicable authority.

UK NACE. United Kingdom National Authority for Counter-Eavesdropping and national technical authority for technical security.

Whole-envelope analysis. Assessment of all direct, flanking, service, structural and operational paths affecting the installed room.

Whole-room evidence. Evidence representing the combined installed configuration and credible states rather than one component.

Chapter 31. Canadian Physical Security, Acoustic Security, EMSEC, and Public Secure-Facility Doctrine

Canadian secure-facility practice is not one standard, one ministry, one room rating or one approval; it is a layered assurance system in which Treasury Board policy, departmental governance, RCMP physical-security zoning, PSPC industrial-security processes, Cyber Centre authority, building regulation, engineering evidence and operating control converge upon a defined mission and configuration.[231]

The central forensic and engineering proposition is deliberately narrow. A room may exhibit strong airborne isolation and still fail because a listener can enter an adjoining zone, a duct remains open, a conferencing platform exports audio, an EMSEC condition is unexamined, a contract site lacks the required capability, or the responsible authority has not granted permission for the intended use. Conversely, a public control may be properly implemented while a different security proposition remains untested.

This chapter relies upon public, lawfully accessible, or author-supplied material; protected Canadian criteria are identified only to the extent that their public title, issuer, institutional role, or access status may properly be stated; undisclosed thresholds, restricted procedures, and classified technical detail are neither inferred nor reconstructed.

231 MB-0803. International Electrotechnical Commission, IEC 61260.

Figure 31-1. Canadian secure-facility assurance links policy, departmental governance, technical authority, evidence, operations and authorised use. Author's original diagram.

31.1 Government-wide security governance and departmental accountability

Canadian secure-facility work begins with government-wide policy but becomes real through departmental accountability; the deputy head, chief security officer, programme authority, real-property authority, information-technology authority and facility operator do not perform interchangeable functions.[232]

A protected discussion depends upon a chain of decisions covering people, information, rooms, systems, contracts and operating conditions; one weak decision can defeat a technically competent enclosure, because authority, configuration and use remain part of the protected state.

The project charter should identify each accountable official, delegated authority, decision product and escalation route; governance records should distinguish who specifies a control, who implements it, who tests it, who accepts residual risk and who authorises use.

Evidence includes approved terms of reference, delegated authorities, decision logs, meeting records, signed requirements, issue registers and dated approvals; each record should identify the version of the controlling policy and the exact facility or operating state to which the decision applies.

Common failure modes include an acoustical consultant being treated as the security authority, an operator assuming that construction completion equals authorisation, and a contractor relying on oral direction that cannot be traced after turnover.

232 MB-0862. International Organization for Standardization, ISO 16063-21:2003.

Public policy establishes the governance framework. It does not disclose or replace project-specific secure-room criteria, competent-authority decisions or protected technical direction.

Table 31-1. Canadian secure-facility authority and evidence responsibilities

Role or authority	Primary public function	Representative evidence	Boundary
Deputy head / departmental governance	Accountability for departmental security management	Delegations, policy decisions, risk acceptance	Does not replace specialist technical assessment
Chief Security Officer	Security leadership, coordination and assurance	Security plans, decisions, event and compliance records	Authority depends upon delegation and instrument
Business owner	Operational need, mission and authorised use	Operational requirement, room-use profile, consequence statement	Cannot self-authorise technical compliance
Technical specialists	Design, measurement and diagnosis within discipline	Calculations, drawings, raw data, reports	Do not grant institutional authority unless separately delegated
Competent accreditation authority	Approval, conditions and authority to operate	Accreditation record, conditions, issue disposition	Decision applies only to defined facility and configuration

Worked example 31.1. Governance closure ratio

Engineering question. A project requires 22 named authority decisions before commissioning. Eighteen have signed records. What is the governance closure ratio?

C_g is governance closure, N_c is the number of closed decisions, and N_r is the number of required decisions.

Dimensional check. Like counts or like quantities cancel, leaving a dimensionless fraction, percentage, probability or rate normalised to the stated basis.

Engineering interpretation. Four authority decisions remain open. Commissioning may proceed only if the governing plan permits work before those decisions and prevents premature use.

Uncertainty and valid range. Counting uncertainty is zero when the register is reconciled, but classification of a record as closed can still require judgement.

What the calculation does not establish. The ratio measures documentary closure. It does not show whether the decisions are technically correct or whether authority to operate has been granted.

31.2 Policy instruments, standards, guidance and controlled project criteria

The Canadian source hierarchy contains statutes, Treasury Board policy instruments, departmental procedures, PSPC contract-security requirements, RCMP physical-security guidance, Cyber Centre publications, codes and consensus standards. Their legal and technical effects differ.[233]

A title or shared vocabulary does not make two documents equivalent; a policy may allocate accountability, a standard may define a test quantity, a guide may describe good practice, and a protected publication may contain the controlling technical criteria for a narrow security domain.

The source-control process should record issuer, identifier, edition, effective date, status, jurisdiction, accessibility, project role and limitation; controlled sources should be cited by existence and authority without recreating protected content in an open manuscript.

233 MB-0857. International Organization for Standardization, ISO 16063-11:1999.

A source-freeze register, supersession review, issue log and claim-to-source matrix provide the evidentiary spine; when a source changes, the project should assess affected requirements, drawings, specifications, tests and approvals before assuming continuity.

Failures arise when teams quote obsolete webpages, use a standard outside its scope, confuse public summaries with controlled criteria, or silently import foreign terminology into Canadian governance.

This chapter uses public sources to explain relationships and engineering logic. It cannot establish hidden thresholds or certify that a particular facility complies with protected requirements.

Worked example 31.2. Source-status verification coverage

Engineering question. A chapter contains 34 controlling source records. Thirty-one were verified within the source-freeze period. What proportion is current?

C_s is source verification coverage, N_v is verified records, and N_s is all controlling source records.

Dimensional check. Like counts or like quantities cancel, leaving a dimensionless fraction, percentage, probability or rate normalised to the stated basis.

Engineering interpretation. Three records require resolution, replacement or exclusion before their propositions can be treated as current.[234]

Uncertainty and valid range. The principal uncertainty concerns whether a source changed without an obvious date or notice.

234 MB-0308. ASTM International, ASTM E779-19.

What the calculation does not establish. Coverage does not establish that each source was applied correctly or that proprietary clauses were lawfully obtained.

31.3 Chief Security Officer, business owner and competent-authority separation

The chief security officer provides institutional security leadership, while the business owner defines the operational need and the competent technical or accreditation authority decides specialised propositions within its mandate; a clear separation prevents self-approval.[235]

The room may involve acoustic performance, construction security, information technology, COMSEC, EMSEC, fire protection, accessibility and operational security. Each discipline has different evidence, failure mechanisms and authority boundaries.

A responsibility assignment matrix should name the accountable decision maker, responsible technical lead, consulted specialists and informed stakeholders for every deliverable; it should also define who may stop work and who may accept temporary restrictions.

Evidence should include role letters, organisational charts, RACI matrices, approval signatures, assessor independence statements, declared conflicts and records of authority consultation.

A frequent defect is circular assurance, where the designer selects the requirement, performs the test and declares acceptance; another is fragmented assurance, where each discipline passes its own component while no authority reviews the combined room state.

235 MB-0911. International Organization for Standardization, ISO 9972:2015.

Independence does not require institutional isolation, but the report must disclose relationships and preserve a review path proportionate to consequence.

Worked example 31.3. Authority ambiguity index

Engineering question. A responsibility matrix contains 48 decision rows. Six rows name more than one accountable authority. Calculate the ambiguity index.

A_i is the ambiguity index, N_a is ambiguous decision rows, and N_d is all decision rows.

Dimensional check. Like counts or like quantities cancel, leaving a dimensionless fraction, percentage, probability or rate normalised to the stated basis.

Engineering interpretation. The six rows should be resolved because shared accountability can conceal who owns residual risk and final approval.

Uncertainty and valid range. The count is repeatable if the definition of ambiguous is fixed before review.

What the calculation does not establish. A low index does not prove that named officials possess the required delegated authority.

31.4 Threat, vulnerability, injury and threat-and-risk assessment

Canadian security planning is risk based. The facility team should identify assets, potential injury, credible threat actors, access opportunities, vulnerabilities, existing safeguards and operational consequences before selecting acoustic or technical controls.[236]

Speech risk is time dependent and path dependent; a conversation can be exposed through airborne transmission, structure-borne vibration, ducts, electronic equipment, compromised systems, optical observation, insider access or repeated fragments collected across several events.

The threat and risk assessment should state source levels, languages, durations, adjoining populations, access windows, equipment states, building changes and emergency conditions; mitigations should be linked to identified paths rather than selected from a generic checklist.

Evidence comprises threat statements, site surveys, access maps, listener-position inventories, operating-state matrices, incident history, vulnerability observations and residual-risk decisions.

Weak assessments use a single broadband rating as a proxy for all threats, assume that an empty corridor represents every receiving condition, or omit after-hours maintenance and neighbouring tenancy changes.

The assessment is a decision aid. It does not authorise sensitive discussion or disclose intelligence about actual threat actors beyond the approved need-to-know boundary.

Worked example 31.4. Risk screening score

Engineering question. A receiving-space scenario is assigned likelihood 3, consequence 5 and exposure factor 4 on project scales. What is the unnormalised screening score?

236 MB-0204. ASTM International, ASTM E1186-22.

R_s is the screening score, L is likelihood, C is consequence, and E is exposure opportunity.

Dimensional check. Each term uses the units defined for the example, and the final unit follows directly from the stated arithmetic.

Engineering interpretation. The score ranks this scenario against others using the same scales and definitions.[237]

Uncertainty and valid range. Ordinal ratings create judgement uncertainty and should be supported by scenario notes and sensitivity checks.

What the calculation does not establish. The score is not an annual probability, a monetary loss or a Government of Canada acceptance threshold.

31.5 Information categorisation, classification and conversation consequence

Protected and classified information categories express different forms and degrees of expected injury; the room requirement should therefore begin with the authorised information category and the consequence of unauthorised disclosure, not with a preferred wall assembly.[238]

Conversation consequence is shaped by content, aggregation, repetition, context and recoverability; short names, dates, quantities, access codes and operational commands can carry high consequence even when ordinary sentences remain difficult to understand.

The owner should define authorised information levels, prohibited content, mixed-level meeting rules, visual displays, written notes, recordings, remote

237 MB-0896. International Organization for Standardization, ISO 6781-1:2023.
238 MB-0878. International Organization for Standardization, ISO 18434-1:2008.

participants and escalation conditions; markings and briefings should remain consistent across physical and digital media.

Evidence includes security categorisation decisions, meeting-use profiles, scripts for validation, information-flow diagrams, briefing records and controls for notes, displays and transient data.

Failure occurs when the facility is described as secure without identifying what may be discussed, when users infer that personnel clearance alone permits access, or when repeated low-level fragments create a more sensitive aggregate.

Public categorisation language supports governance analysis but does not disclose project-specific classification guides or the content of protected discussions.

Worked example 31.5. High-consequence fragment fraction

Engineering question. A validation script contains 120 utterances, of which 18 are names, codes, dates or short commands. What fraction tests high-consequence fragments?

F_h is the high-consequence fraction, N_h is high-consequence utterances, and N_t is total utterances.

Dimensional check. Counts cancel where divided, while time products or quotients retain hours or months as shown.

Engineering interpretation. The script contains a meaningful but limited subset of compact information forms that can remain recoverable when long sentences do not.

Uncertainty and valid range. Categorisation uncertainty arises when an utterance combines ordinary and high-consequence content.

What the calculation does not establish. The fraction does not establish an acceptance criterion or represent actual meeting content.

31.6 Need-to-know, need-to-access and security screening

Security status or clearance is necessary for many sensitive roles, but access also depends upon need-to-know, need-to-access, assignment, briefing and current authorisation; the distinction applies to occupants, cleaners, maintainers, investigators, visitors and remote support staff.[239]

Access is both spatial and informational; a person may be authorised to enter a zone without authority to hear a meeting, view a display, inspect technical drawings or retrieve system logs; acoustic listener access must therefore be analysed separately from badge access.

The access-control plan should map roles to zones, information, systems, time windows and escort conditions; temporary access should be bounded, recorded and reviewed rather than used as a substitute for appropriate screening.

Evidence includes screening confirmations, access lists, need-to-know approvals, visitor records, escort logs, temporary-access decisions, revocation records and periodic reconciliations between personnel and system directories.

Failures include dormant credentials, inherited access groups, unsupervised service personnel, visitors positioned near weak boundaries, and authorised personnel receiving information outside their duties.

239 MB-0910. International Organization for Standardization, ISO 9712:2021.

Screening information is sensitive personal information. The facility record should prove that access conditions were verified without unnecessarily reproducing personal screening data.

Worked example 31.6. Screening and need-to-know coverage

Engineering question. Forty personnel can enter the operations zone; thirty-eight have current screening, but only 31 have documented need-to-know for the project; what is effective authorised coverage?

C_a is effective authorised coverage, N_b is personnel meeting both conditions, and N_z is personnel with zone access.

Dimensional check. Like counts or like quantities cancel, leaving a dimensionless fraction, percentage, probability or rate normalised to the stated basis.

Engineering interpretation. Nine people require access review, reassignment, escort controls or removal from the relevant access group.[240]

Uncertainty and valid range. Personnel records may change between the data extract and the physical access review.

What the calculation does not establish. The calculation does not imply that the 31 people need access at all times or to every conversation.

31.7 Five-zone physical-security architecture

The RCMP public zoning model distinguishes public, reception, operations, security and high-security zones; the zones create progressively controlled environments, but their application remains risk based and must be integrated with the actual building and organisational mission.[241]

240 MB-0803. International Electrotechnical Commission, IEC 61260.
241 MB-0984. JCGM 100:2008.

Zone boundaries affect acoustic exposure by changing who may occupy adjacent space, how close listeners may approach, how long they may remain and whether they can manipulate doors, ceilings, services or equipment; geometry and occupancy matter as much as the zone label.

The room data sheet should identify the zone on every face of the enclosure, transition points, required screening, escort rules, access-control devices, observation opportunities and after-hours state; plans should include vertical and service-space relationships.

Evidence includes approved zoning drawings, door schedules, access matrices, alarm zoning, CCTV coverage, visitor routes, server and service-space locations, and records showing that the as-built configuration matches the approved hierarchy.

A zone can be undermined by shared risers, ceiling spaces, unlocked interconnecting doors, uncontrolled loading docks or landlord access. A high-security label cannot cure a physical path that remains open.

Zoning is not an acoustic rating, an EMSEC evaluation or authority to operate a specialised facility. It is one layer in the complete security case.

Table 31-2. Physical-security zones and acoustic listener-access implications

Zone	**Public purpose in hierarchy**	**Acoustic-security question**	**Typical evidence**
Public zone	Open or broadly accessible area	Can an uncontrolled listener approach, remain or use equipment near the boundary?	Access map, occupancy, background, exterior survey
Reception zone	Initial controlled transition	Can visitors wait, hear or observe before escort?	Reception layout, visitor process, queue positions

Zone	Public purpose in hierarchy	Acoustic-security question	Typical evidence
Operations zone	Controlled work area	Which authorised personnel can occupy adjoining rooms without need-to-know?	Role matrix, badge groups, schedules
Security zone	Restricted area for sensitive assets or work	Are ceiling, floor, service and maintenance routes controlled to the same standard?	Plans, access logs, inspection rights
High-security zone	Most restrictive public zone concept	What enhanced access, monitoring and lifecycle controls support the specific threat case?	Approved zoning, alarm and change records

Figure 31-2. Government of Canada five-zone hierarchy with an acoustic listener-access overlay. Author's original diagram.

Worked example 31.7. Zone-transition control density

Engineering question. A route from public space to a high-security zone crosses four controlled transitions over a travel distance of 52 m. What is the transition density?

D_z is transition density, N_t is controlled transitions, and d is route distance.

Dimensional check. Like counts or like quantities cancel, leaving a dimensionless fraction, percentage, probability or rate normalised to the stated basis.

Engineering interpretation. The numerical density supports comparison of routes but should be read with the quality, delay and monitoring of each transition.

Uncertainty and valid range. Distance measurement uncertainty of ±1 m changes the result by about two per cent.

What the calculation does not establish. More transitions do not automatically provide better security and can create tailgating or emergency-egress problems.

31.8 Zone boundaries and acoustic listener-access analysis

Acoustic analysis should translate zone architecture into a listener-access model; for each boundary face, the analyst identifies who can occupy the receiving space, their distance, duration, concealment, equipment access and ability to repeat observations.[242]

A quiet authorised office can present greater speech-recovery opportunity than a noisy public corridor, even though the office is more controlled; conversely, a public space may become critical after hours when background sound falls and dwell time increases.

The test plan should define representative and worst credible receiver positions for occupied, unoccupied, maintenance, emergency and degraded states. Movable furniture and temporary partitions should not conceal untested access geometry.

Evidence includes annotated plans, three-dimensional path diagrams, time-of-day occupancy data, background spectra, source-to-receiver distances, photographs and records of inaccessible cavities or landlord-controlled spaces.

242 MB-1046. National Institute of Standards and Technology, FIPS PUB 180-4, Secure Hash Standard.

Failures arise from testing only the nearest point, averaging away a local leak, excluding ceiling or underfloor access, or assuming that a controlled zone prevents deliberate listening by an authorised insider.

The analysis ranks opportunities under stated assumptions. It does not claim that every possible listener, device or future building state has been eliminated.

Worked example 31.8. Time-weighted listener exposure

Engineering question. A corridor is accessible for 10 hours at exposure weight 1, while a quiet maintenance space is accessible for 2 hours at weight 4. What is the weighted exposure?

E_w is weighted exposure, t_i is access duration, and w_i is a project-defined opportunity weight.

Dimensional check. Counts cancel where divided, while time products or quotients retain hours or months as shown.

Engineering interpretation. The two maintenance hours contribute eight weighted hours and therefore deserve explicit testing and control.[243]

Uncertainty and valid range. The weights are judgemental and should be tested through sensitivity analysis.

What the calculation does not establish. Weighted hours are a screening index, not a probability that speech will be recovered.

243 MB-1052. National Institute of Standards and Technology, NISTIR 8387, Digital Evidence Preservation: Considerations for Evidence Handlers.

31.9 Multi-tenant buildings, landlord interfaces and common areas

Multi-tenant buildings divide authority among the Government of Canada organisation, landlord, property manager, other tenants, service contractors and public users; secure-room design must identify which party controls each boundary, service and access route.[244]

Shared façades, slabs, plenums, washrooms, risers, loading areas, lift lobbies and plant rooms create acoustic and physical dependencies. Lease boundaries rarely coincide with technical transmission boundaries.

The project should establish landlord obligations for access notice, work approval, service isolation, incident reporting, drawing control and post-construction changes. Sensitive details should be minimised and distributed on a need-to-know basis.

Evidence includes lease clauses, interface matrices, access agreements, landlord work permits, tenant notifications, base-building drawings, service inventories and inspection rights.

Common failures include unannounced landlord works, shared keys, ceiling access from another tenancy, undocumented valve or cable changes, and facilities staff who can enter without the secure-room operator being alerted.

Contractual control reduces risk but does not replace technical verification. The report should state which spaces were inaccessible and which assumptions depend upon another party.

244 MB-1053. National Institute of Standards and Technology, NISTIR 8387, Digital Evidence Preservation: Considerations for Evidence Handlers.

Worked example 31.9. Third-party interface closure

Engineering question. A landlord interface schedule contains 27 obligations. Twenty-three have evidence of implementation. Calculate closure.

C_l is landlord-interface closure, N_i is implemented obligations, and N_o is all obligations.

Dimensional check. Like counts or like quantities cancel, leaving a dimensionless fraction, percentage, probability or rate normalised to the stated basis.

Engineering interpretation. Four unresolved obligations could involve access notice, service changes, work permits or incident reporting.

Uncertainty and valid range. Evidence quality can vary even when an item is marked complete.

What the calculation does not establish. The ratio does not prove that contractual remedies are enforceable or that technical performance is satisfactory.

31.10 Temporary zones, changing hours and time-dependent controls

Zones and access conditions can change during construction, renovation, emergency response, special events or temporary operations; a room acceptable in its normal state may become exposed when adjacent space changes use or control.[245]

Time-dependent risk includes quiet nights, reduced HVAC, cleaning shifts, maintenance windows, temporary scaffolding, construction openings and

245 MB-0891. International Organization for Standardization, ISO 3382-2:2008.

disabled alarms; acoustic security is therefore a function of state and schedule, not a permanent material property.

Temporary-zone plans should identify start and end times, physical barriers, signage, screening, escorts, prohibited activities, daily inspections and restoration evidence; the authority should define what information may be discussed during the temporary state.

Evidence includes temporary-zone approvals, shift logs, daily condition checks, photographs, permit closures, alarm records and a signed return-to-service decision.

Failures occur when temporary controls persist without review, construction workers gain access beyond their task, barriers are removed early, or operations resume before penetrations and ceiling closures are verified.

Temporary measures should be proportionate and explicit. They should not be represented as permanent accreditation or used to bypass a required specialised-facility process.

Worked example 31.10. Temporary-state availability

Engineering question. A temporary protected area operates for 21 days. Daily condition checks passed on 19 days. What is verified availability?

A_t is verified temporary-state availability, N_p is passing days, and N_d is operating days.

Dimensional check. Like counts or like quantities cancel, leaving a dimensionless fraction, percentage, probability or rate normalised to the stated basis.

Engineering interpretation. Two days lack passing evidence and should be treated as unverified unless contemporaneous records resolve them.[246]

Uncertainty and valid range. A daily check samples conditions and may not capture an intra-day change.

What the calculation does not establish. Availability does not establish permanent approval or show that every discussion complied with restrictions.

31.11 Document safeguarding capability and secure work-site approval

The Contract Security Program uses document safeguarding capability to authorise an organisation to store, handle and protect sensitive information or assets at identified work sites; the public process includes inspection, recommendations, implementation and written approval.[247]

A secure discussion room may sit within a site that has broader safeguarding responsibilities; paper, displays, meeting notes, recordings, system logs and test data can create information-protection obligations beyond the acoustic enclosure.

The contract security plan should identify required organisation screening, site capability, information level, storage, destruction, IT processing, security orders and authorised locations; work should not begin on assumptions that written approval will arrive later.

246 MB-0913. International Organization for Standardization, ISO/IEC 17025:2017.
247 MB-0984. JCGM 100:2008.

Evidence includes the security requirements check list, contract clauses, floor plans, inspection records, corrective-action closure, written CSP notification and internal security orders acknowledged by personnel.

Failure modes include moving information to an unapproved room, storing test media overnight without authority, using an approved site for a new contract without reviewing scope, and treating inspection recommendations as optional.

Document safeguarding approval is not automatically a speech privacy room accreditation, an EMSEC evaluation or a COMSEC authority.

Worked example 31.11. Approved work-site coverage

Engineering question. An organisation uses five project work sites. Four have written document safeguarding capability for the required information level. What is site coverage?

C_w is approved-site coverage, N_a is approved sites, and N_s is sites used by the project.

Dimensional check. Like counts or like quantities cancel, leaving a dimensionless fraction, percentage, probability or rate normalised to the stated basis.

Engineering interpretation. The fifth site should not store or handle the relevant information until written approval is obtained.

Uncertainty and valid range. The count assumes that approval remains current and covers the actual contract activity.

What the calculation does not establish. The ratio does not establish specialised-facility accreditation or IT processing authority.

31.12 DOS, FSC and site-specific safeguarding distinctions

Designated organisation screening and facility security clearance establish different organisational permissions for protected and classified work. Additional capabilities govern storage, production, destruction, information-technology processing and COMSEC-related activity at particular sites.[248]

The facility team must distinguish personnel access from organisational eligibility and site capability; a cleared person can still lack need-to-know, while a cleared organisation can lack authority to store or process material at a given location.

The requirements matrix should link each contract activity to information level, organisation screening, personnel screening, site, document safeguarding, IT processing, production and specialised-facility needs.

Evidence includes CSP letters, contract clauses, SRCL records, site capability approvals, personnel-status confirmation and records of limitations or conditions.

Failures include assuming that an FSC authorises every site, confusing DOS with classified storage authority, or using an approved conference area for a more sensitive purpose than the written capability permits.

Public summaries support classification of approval types. The actual contract and CSP correspondence control the organisation and site.

Table 31-3. Organisation screening and site-capability distinctions

248 MB-0998. Joint Committee for Guides in Metrology, JCGM GUM-1:2023 and JCGM GUM-6:2020, 2023 and 2020. Status at the 14 August 2026 source freeze: Published and current at source freeze. Public locator: Use is confined to the source scope. The docume.

Approval or capability	General public role	What it does not automatically provide
Designated organisation screening	Organisation eligibility for protected contract activity within scope	Classified access, site storage, IT processing or specialised-facility approval
Facility security clearance	Organisation eligibility for classified contract activity within scope	Authority for every site, every information level or every person
Document safeguarding capability	Site authority to store, handle and protect stated information or assets	Speech privacy room accreditation or COMSEC / EMSEC approval
Authority to process IT	Electronic processing and transmission for stated contract and site	Physical acoustic isolation or authority for classified discussion
Specialised-facility accreditation	Approval of a defined specialised facility and configuration	Blanket approval of future changes, other sites or other missions

Worked example 31.12. Capability alignment fraction

Engineering question. A contract requires eight distinct capabilities. The supplier currently holds six applicable approvals. Calculate the alignment fraction.

F_c is capability alignment, N_h is held applicable approvals, and N_r is required capabilities.

Dimensional check. Like counts or like quantities cancel, leaving a dimensionless fraction, percentage, probability or rate normalised to the stated basis.

Engineering interpretation. Two capability gaps must be closed, removed from scope or controlled through an authorised alternative.[249]

249 MB-1046. National Institute of Standards and Technology, FIPS PUB 180-4, Secure Hash Standard.

Uncertainty and valid range. Applicability may depend upon site, information level and contract wording.

What the calculation does not establish. The calculation does not permit one approval to be treated as equivalent to another.

31.13 Sponsor, Contract Security Program and Field Industrial Security Officer roles

Specialised secure work in industry requires coordinated action by the Government of Canada sponsor, Contract Security Program and Field Industrial Security Officer, together with the contractor security organisation and relevant technical authorities.[250]

The sponsor establishes the operational requirement and confirms that specialised controls are justified. The CSP governs industrial-security approvals, while the FISO examines site conditions and required corrective measures within the programme process.

The project schedule should include sponsor submissions, pre-inspection information, site visits, corrective work, evidence review and written approvals. Construction sequencing should respect the need for review before concealed conditions become inaccessible.

Evidence includes sponsor justification, correspondence, inspection questionnaires, floor plans, photographs, findings, corrective-action records and approval letters.

A common failure is to design or build a specialised room before consulting the CSP, thereby creating rework, evidence gaps or loss of accreditation

250 MB-1052. National Institute of Standards and Technology, NISTIR 8387, Digital Evidence Preservation: Considerations for Evidence Handlers.

potential; another is to assume that a contractor proposal binds the competent authority.

Public descriptions identify the process and parties. They do not reveal protected facility criteria or guarantee approval for a proposed design.

Worked example 31.13. Inspection workload estimate

Engineering question. A FISO review covers 36 rooms, 18 controlled doors and 42 sensitive assets; a planning coefficient assigns 0.5 hour per room, 0.25 hour per door and 0.2 hour per asset. Estimate field time.

T_f is field time, N_r is rooms, N_d is doors, and N_a is assets.

Dimensional check. Counts cancel where divided, while time products or quotients retain hours or months as shown.

Engineering interpretation. The estimate supports scheduling approximately four working days before travel, reporting and corrective follow-up.

Uncertainty and valid range. Coefficients are project planning assumptions and may vary with complexity and evidence quality.

What the calculation does not establish. This is not a PSPC service standard or commitment concerning actual inspection duration.

31.14 Specialised secure facilities and speech privacy rooms

The Contract Security Manual publicly identifies speech privacy rooms and sensitive compartmented information facilities as specialised secure facilities that protect classified information beyond ordinary document safeguarding capability.[251]

251 MB-1048. NIST SP 800-82.

Such a facility is a system of construction, technical controls, administration, personnel, communications, information technology and operating rules. Acoustic isolation is essential to a speech privacy proposition but remains only one component.

The sponsor should define the authorised mission, information levels, occupancy, communications, adjoining access, maintenance, emergency states and lifecycle support. The design team should route sensitive criteria through approved channels.

Evidence includes sponsor approval, controlled design documents, inspection and test records, configuration baselines, deficiency closure, accreditation records and authority-to-operate conditions.

Failures include equating a high STC assembly with a speech privacy room, starting construction before authority engagement, omitting communications or EMSEC interfaces, and allowing later work to alter the approved configuration.

This chapter explains the public process. It intentionally excludes protected construction details, performance thresholds and acceptance procedures.

Table 31-4. Publicly described specialised-facility process

Stage	Principal action	Evidence product	Principal risk if omitted
Need definition	Government sponsor justifies specialised facility	Approved operational requirement	Construction without authorised need
Early authority engagement	Sponsor and CSP confirm process before construction	Correspondence and controlled criteria route	Rework or loss of accreditation potential
Controlled design and construction	Implement authorised multidisciplinary requirements	Drawings, inspections, configuration records	Concealed nonconformance or uncontrolled disclosure

Stage	Principal action	Evidence product	Principal risk if omitted
Evaluation and deficiency closure	Test and inspect the installed system	Reports, issue register, corrective evidence	False confidence from incomplete testing
Accreditation and authority to operate	Responsible authority decides use and conditions	Written decision and operating restrictions	Premature or unauthorised use

Worked example 31.14. Specialised-facility readiness index

Engineering question. A readiness register contains 40 prerequisites; thirty-four are closed, three are conditionally controlled and three are open; conditional items receive weight 0.5. Calculate readiness.

R_f is readiness, N_c is closed items, N_k is conditional items, and N_t is total prerequisites.

Dimensional check. Like counts or like quantities cancel, leaving a dimensionless fraction, percentage, probability or rate normalised to the stated basis.

Engineering interpretation. The index shows remaining work but does not override any mandatory open prerequisite.[252]

Uncertainty and valid range. Weights are a planning convention and should be disclosed.

What the calculation does not establish. Readiness below or above any chosen percentage is not authority to operate.

31.15 Accreditation and authority to operate

Accreditation and authority to operate are decisions by the responsible authority concerning a defined facility, purpose, configuration and set of

252 MB-0913. International Organization for Standardization, ISO/IEC 17025:2017.

conditions; they are not automatic consequences of procurement, construction completion or a favourable acoustic report.[253]

The decision integrates evidence from security governance, construction, technical testing, personnel, systems, communications, operations and residual risk. Conditions may restrict information level, occupancy, equipment, adjoining use or duration.

The accreditation package should identify the approved baseline, open findings, compensating measures, responsible officials, expiry or review triggers and change-control obligations. Use should begin only after the required written decision.

Evidence includes authority correspondence, inspection reports, test records, deficiency registers, waivers or exceptions, residual-risk acceptance, configuration lists and signed operating conditions.

Failures occur when teams use the room during a presumed administrative delay, treat an interim condition as permanent, or continue operation after a material change without consulting the authority.

A public-source manuscript cannot confer authority to operate. Only the authorised Canadian process can do so for the actual facility.

Worked example 31.15. Authority-to-operate evidence closure

Engineering question. An accreditation package requires 58 evidence items. Fifty-five are accepted, two require clarification and one is missing. What is strict closure?

C_o is strict closure, N_a is accepted items, and N_r is required items.

253 MB-0801. International Electrotechnical Commission, IEC 60942:2017.

Dimensional check. Like counts or like quantities cancel, leaving a dimensionless fraction, percentage, probability or rate normalised to the stated basis.

Engineering interpretation. Three items remain unresolved. Their significance depends upon authority judgement, not percentage alone.

Uncertainty and valid range. Acceptance status can change after authority review.

What the calculation does not establish. A high closure percentage does not permit use before written authority to operate.

31.16 Verbal and message communication controls

Sensitive speech can leave a room through telecommunications as readily as through walls. Telephone, conferencing, radio, messaging and facsimile controls must align with information category, approved systems and the communications-security authority.[254]

Speakerphones, open microphones, remote participants, automatic recording, transcription, cloud services and diagnostic channels alter the communication boundary. Muting a user interface does not necessarily disable every acquisition or transmission path.

The operating procedure should define approved devices, call setup, participant authentication, prohibited features, recording controls, incident response and the point at which a room restriction overrides business convenience.

254 MB-1245. U.S. Department of Defense, UFGS 01 91 00.15, Building Commissioning.

Evidence includes approved equipment lists, configuration exports, call records where authorised, feature-disablement evidence, user briefings, maintenance logs and test results for mute, standby and emergency states.

Failures include using unprotected communications above their authorised level, relying on consumer indicators, permitting unauthorised remote support or leaving conference systems in unattended auto-answer modes.

This chapter does not describe cryptographic methods, keying material or operational COMSEC procedures. Those matters remain within authorised channels.

Worked example 31.16. Communication attenuation margin

Engineering question. An unprotected voice path produces 42 dB at the source reference and 18 dB at an accessible receiver. Background is 23 dB. What is the received speech-to-background margin?

M_sb is speech-to-background margin, L_r is received speech level, and L_b is background level in the same band.

Dimensional check. Logarithmic levels use compatible references, so the reported difference or equivalent level remains in decibels.

Engineering interpretation. A negative margin suggests reduced audibility in that band, but intelligibility depends upon other bands, temporal structure and listener conditions.[255]

Uncertainty and valid range. Level uncertainty of ±1.5 dB yields margin uncertainty of about ±2.1 dB when independent.

255 MB-0913. International Organization for Standardization, ISO/IEC 17025:2017.

What the calculation does not establish. The calculation does not authorise use of an unprotected communication system.

31.17 Voice and audio technology for public-facing services

Public-facing voice and audio technology can support government services involving unclassified and protected information within the scope of current Cyber Centre direction; its presence in a secure facility still requires a bounded use case.[256]

Microphones, headsets, hearing assistance, speech analytics, interactive voice systems and transcription can create data flows through endpoints, networks and service providers; acoustic privacy in the room does not control those external processing chains.

The system design should document information level, user population, data routing, retention, accessibility, service-provider controls, fallback modes and prohibited uses; the room procedure should state when the technology must be removed or disabled.

Evidence includes architecture diagrams, privacy and security assessments, configuration records, approved service lists, data-retention settings, accessibility testing and operational training.

Failures include applying a public-facing authorisation to classified discussion, assuming a headset prevents environmental pickup, or overlooking recordings and transcripts retained by a service.

The public direction should be applied only within its stated scope. Specialised secure-facility use remains subject to separate authority.

256 MB-0984. JCGM 100:2008.

Worked example 31.17. Approved audio-state coverage

Engineering question. A public-facing audio system has 12 operating states. Nine have documented approval and functional tests. What is state coverage?

C_v is approved audio-state coverage, N_a is approved tested states, and N_t is all states.

Dimensional check. Like counts or like quantities cancel, leaving a dimensionless fraction, percentage, probability or rate normalised to the stated basis.

Engineering interpretation. Three states, often maintenance, failure or fallback modes, remain outside the evidence baseline.

Uncertainty and valid range. State enumeration can miss undocumented vendor behaviours.

What the calculation does not establish. Coverage within public-facing guidance does not permit classified use.

31.18 Authorised room uses and source-state basis of design

A room should be designed and tested against defined authorised uses. Ordinary meetings, raised voices, teleconferences, briefings, interviews, interpretation, emergency operations and maintenance create different acoustic and technical source states.[257]

Source level, spectrum, directivity, duration, occupancy, seating and equipment determine incident energy at the boundary. The loudest credible

257 MB-1052. National Institute of Standards and Technology, NISTIR 8387, Digital Evidence Preservation: Considerations for Evidence Handlers.

authorised source may be a loudspeaker or remote participant rather than a natural talker.

The basis of design should list source states, prohibited states, simultaneous systems, door positions, HVAC modes, masking conditions, adjoining occupancy and background assumptions; each acceptance test should map to at least one authorised use.

Evidence includes room data sheets, source-state matrices, calibrated playback files, equipment inventories, seating plans, operating procedures and commissioning records.

Failures arise when testing uses a convenient source level below operational reality, when amplified systems are commissioned after acoustic acceptance, or when emergency modes bypass the assumed configuration.

Source-state definition supports engineering comparison. It does not by itself decide which information may be discussed.

Worked example 31.18. Energetic combination of source states

Engineering question. Two independent sources produce 78 dB and 74 dB at a boundary. What is the combined level?

L_Σ is combined level, and $L1$ and $L2$ are individual sound-pressure levels under compatible references.

Dimensional check. Logarithmic levels use compatible references, so the reported difference or equivalent level remains in decibels.

Engineering interpretation. The louder source dominates, but the second source adds about 1.5 dB.[258]

Uncertainty and valid range. Phase and coherence can alter instantaneous results; the expression assumes energetic addition.

What the calculation does not establish. The result does not predict transmitted level without path data.

31.19 Acoustic measurands and bounded security inference

Different acoustic quantities answer different questions. Transmission loss describes a specimen, field level difference describes installed room relationships, reverberation time describes decay, and speech metrics estimate listener outcomes under stated conditions.[259]

No single number proves a secure room; broadband classes can hide frequency-specific weakness, local leaks and state changes; speech intelligibility depends upon source, path, background, listener, language and exposure.

The test specification should define the measurand, method, edition, frequency range, positions, source states, corrections, uncertainty, decision rule and limitation. Results should be reported by band where path diagnosis matters.

Evidence includes calibration records, raw spectra, position logs, background measurements, decay data, uncertainty budgets, photographs and processed results traceable to the raw data.

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258 MB-0248. ASTM International, ASTM E3176-24, ASTM E620-18.
259 MB-0871. International Organization for Standardization, ISO 16283-1:2014.

Failures include substituting laboratory STC for installed performance, using A-weighted averages to characterise speech masking, or presenting a speech metric outside its validated conditions.

Engineering measurements support a bounded proposition. Accreditation and authority decisions remain with the competent Canadian authority.

Table 31-5. Acoustic quantities and defensible inferences

Quantity or evidence	What it characterises	What it cannot prove alone
Laboratory transmission loss / rating	A tested specimen under laboratory conditions	Installed room performance or whole-envelope security
Field level difference / field rating	Installed relationship between rooms under test conditions	Listener outcome in every adjoining state
Reverberation time	Decay behaviour in a room	Boundary isolation, masking adequacy or authority
Speech intelligibility or privacy metric	Listener-related outcome under defined source, background and method	Universal security threshold or accreditation
Local leakage / intensity / vibration evidence	Path localisation and comparative contribution	Complete absence of other paths

Worked example 31.19. Area-weighted composite transmission

Engineering question. A boundary has 19 m^2 with transmission loss 55 dB and a 1 m^2 door with loss 35 dB. What is the composite transmission loss?

R_c is composite loss, S_i is element area, and R_i is element transmission loss.

Dimensional check. Logarithmic levels use compatible references, so the reported difference or equivalent level remains in decibels.

Engineering interpretation. The small door reduces the ideal composite result by more than seven decibels relative to the wall.

Uncertainty and valid range. Input ratings and areas carry uncertainty, and the calculation omits flanking and leakage.

What the calculation does not establish. The result is a screening estimate, not installed field performance or speech-security approval.

31.20 Laboratory and field measurement competence

Competent measurement requires suitable personnel, calibrated instruments, controlled procedures, known limitations and defensible data handling. Laboratory accreditation is valuable only when the actual method and range are within scope.[260]

Field environments introduce non-ideal rooms, flanking, background variation, access constraints and operating-state changes. The investigator should distinguish method requirements from project-specific additions needed to test the security proposition.

The measurement plan should define instruments, calibration, channel matching, source stability, spatial sampling, temporal sampling, environmental conditions, data formats, quality checks and stop-work criteria.

Evidence includes laboratory scope, personnel competence, calibration certificates, field checks, equipment serial numbers, software versions, raw files, processing scripts and review records.

Failures include expired calibration, overloaded channels, insufficient background margin, undocumented averaging, unverified software settings and tests performed in a non-representative state.

260 MB-0246. ASTM International, ASTM E2964-26.

A technically competent test may still be insufficient if the wrong proposition, edition, configuration or authority requirement was selected.

Worked example 31.20. Background-correction eligibility

Engineering question. A receiving measurement is 31 dB and background is 27 dB in one band. What is the level difference?

ΔL is the measured-to-background difference, L_m is total measured level, and L_b is background.

Dimensional check. Logarithmic levels use compatible references, so the reported difference or equivalent level remains in decibels.

Engineering interpretation. The four-decibel separation indicates that background materially affects the result and the applicable method correction or reporting rule must be followed.[261]

Uncertainty and valid range. Repeatability and background non-stationarity can change the difference.

What the calculation does not establish. A simple subtraction of decibels is not the correct energetic background correction.

31.21 Adjoining-space geometry and receiver population

The receiving environment includes every credible adjoining or connected space, not merely the room selected for a standard test; corridors, offices, washrooms, stairs, roofs, ceiling voids, underfloor areas, risers and exterior approaches can carry different risks.[262]

Receiver population, distance, dwell time, concealment, hearing ability and equipment access affect consequence. A local weak path can be missed by

261 MB-0342. ASTM International, ASTM E966-18a.
262 MB-1245. U.S. Department of Defense, UFGS 01 91 00.15, Building Commissioning.

room-average sampling and become significant when a listener can approach closely.

The survey should build a three-dimensional receiver map, classify access populations, identify time-dependent states and assign measurement positions to each material path. Inaccessible areas should be recorded as limitations.

Evidence includes annotated drawings, photographs, access-control records, occupancy schedules, measured background spectra, path traces and position coordinates.

Failures include excluding spaces controlled by another tenant, assuming the floor slab blocks every path, ignoring roof or façade access, and averaging results across zones with materially different listener opportunity.

The receiver model is an evidence-based scenario set. It cannot exhaust every future occupant, device or alteration.

Worked example 31.21. Receiver sampling density

Engineering question. A 96 m^2 accessible receiving area is represented by 24 measurement positions. What is the sampling density?

D_r is position density, N_p is measurement positions, and A is accessible area.

Dimensional check. The multiplication or normalisation of lengths produces square metres or a dimensionless area fraction as stated.

Engineering interpretation. The density supports comparison, but position placement should target doors, grilles, corners and suspected paths rather than a uniform grid alone.

Uncertainty and valid range. Area and position coordinates introduce minor counting uncertainty.

What the calculation does not establish. Density does not prove spatial adequacy without considering acoustic variability and method requirements.

31.22 Doors, frames, seals and controlled entry

Doors combine acoustic, physical-security, fire, accessibility and operational functions. Leaf construction, frame anchorage, perimeter seals, thresholds, hardware, electrification, closers and access control must operate as one system.[263]

Small gaps can dominate a high-performing wall; wear, latch misalignment, threshold damage, propping, cable passage and pressure differences alter the leak state; entry events also create intentional periods of reduced isolation.

The specification should identify tested configurations, permitted hardware, installation tolerances, seal compression, closer force, access-control interfaces, inspection method and maintenance limits.

Evidence includes shop drawings, product reports, frame-plumb records, gap measurements, seal schedules, hardware commissioning, opening-cycle tests and periodic inspection logs.

Failures include substituting untested vision or access hardware, cutting seals for cables, adjusting latches to reduce closing force, or accepting one closed-door measurement without testing operational cycles.

263 MB-1315. Whole Building Design Guide, Public building commissioning resources and current UFGS master.

A compliant fire or security door is not automatically an acoustic-security door. All applicable propositions require separate evidence.

Worked example 31.22. Door-gap open area

Engineering question. A 0.9 m wide door has an average 2.5 mm bottom gap. What is the geometric open area?

A_g is gap area, w is door width, and g is average gap height.

Dimensional check. The multiplication or normalisation of lengths produces square metres or a dimensionless area fraction as stated.

Engineering interpretation. The area appears small but can dominate a high-isolation boundary because it is an acoustically open path.[264]

Uncertainty and valid range. Gap height may vary along the width and during pressure changes.

What the calculation does not establish. Geometric area alone does not predict transmission through seals, labyrinths or thresholds.

31.23 Walls, floors, ceilings and structural flanking

The enclosure is a network of direct and flanking paths through walls, slabs, ceilings, façades, junctions and connected structure; material mass alone cannot describe double-leaf resonance, coincidence, bridging, damping, junction transfer or workmanship.[265]

Continuous structural elements can carry vibration around an otherwise strong partition; lightweight ceilings, raised floors and shared cavities can bypass full-height walls; settlement and movement can open perimeter joints after acceptance.

264 MB-0804. International Electrotechnical Commission, IEC 61672-1:2013.
265 MB-0806. International Electrotechnical Commission, IEC 61672-2:2013.

Design should identify every boundary assembly, junction, resilient connection, structural continuity, movement joint and service intersection. The model should combine laboratory evidence with site-specific flanking analysis.

Evidence includes assembly details, laboratory reports, structural drawings, junction photographs, vibration measurements, as-built inspections and whole-room field results.

Failures include relying on a headline wall rating, allowing resilient channels to be short-circuited, terminating walls at a shared ceiling, or omitting slab-edge and façade paths.

Prediction narrows design choices but cannot substitute for inspection and installed testing of the complete configuration.

Worked example 31.23. Parallel flanking-path sum

Engineering question. Three independent path transmission coefficients are 2×10^{-5}, 6×10^{-6} and 4×10^{-6}. What is the total equivalent loss?

τ_Σ is total transmission coefficient, τ_i are path coefficients, and R_Σ is equivalent loss.

Dimensional check. Logarithmic levels use compatible references, so the reported difference or equivalent level remains in decibels.

Engineering interpretation. The largest path dominates but the two smaller paths reduce total isolation by about 1.8 dB.

Uncertainty and valid range. Path estimates can be correlated and uncertain.

What the calculation does not establish. The example omits coherence, frequency dependence and receiver normalisation.

31.24 HVAC, ducts, plenums and pressure states

HVAC systems can transmit speech through ducts, plenums, grilles, casing breakout and structure-borne vibration. They also create background sound that may assist masking in one state and disappear in another.[266]

Duct geometry, lining, elbows, branches, silencers, dampers, terminal devices, airflow and fan operation determine both attenuation and regenerated noise. Pressure differences can alter door seals and leakage through imperfect joints.

The mechanical design should map each route between protected and accessible spaces, define permitted shared systems, specify silencers and vibration isolation, and identify normal, setback, purge, emergency and maintenance modes.

Evidence includes schematics, acoustic calculations, manufacturer data, inspection photographs, leakage tests, balancing reports, operating-state measurements and maintenance procedures.

Failures include bypass ducts, unlined transfer paths, opened access panels, filter changes that alter airflow, silencers installed backwards, and night modes that remove assumed background sound.

Mechanical compliance and indoor-air performance remain necessary. Acoustic changes should not defeat fire, smoke, ventilation or health requirements.

266 MB-0801. International Electrotechnical Commission, IEC 60942:2017.

Worked example 31.24. Duct-route attenuation balance

Engineering question. A duct path has 18 dB silencer insertion loss, 7 dB elbow attenuation and 5 dB terminal attenuation, but 6 dB regenerated noise penalty. What is the net path attenuation?

A_net is net attenuation, A_s is silencer insertion loss, A_e is elbow attenuation, A_t is terminal attenuation, and P_r is regenerated-noise penalty.

Dimensional check. Logarithmic levels use compatible references, so the reported difference or equivalent level remains in decibels.

Engineering interpretation. The route provides 24 dB under the assumed independent, compatible data.[267]

Uncertainty and valid range. Manufacturer values may depend upon airflow, frequency and installation.

What the calculation does not establish. Arithmetic addition is a screening approximation and does not replace a full duct-acoustic model or field test.

31.25 Penetrations, conduits, cable pathways and service risers

Every service penetration changes the boundary. Pipes, conduits, cable trays, fibre, copper, sleeves, firestop systems and access panels can create open areas, rigid bridges, waveguide paths or future alteration points.[268]

The acoustic effect depends upon annular geometry, fill, seal depth, backing, material stiffness, route length and connected cavities. A visually

267 MB-0862. International Organization for Standardization, ISO 16063-21:2003.
268 MB-0278. ASTM International, ASTM E336-25a.

closed penetration may still contain voids or rigid contact that transfers vibration.

The penetration register should identify unique number, service, location, dimensions, assembly, approved detail, installer, inspection hold point, photograph, firestop system and later change history.

Evidence includes coordinated drawings, sleeves before closure, first-of-type mock-ups, product identification, depth measurements, photographs, inspection sign-off and targeted leakage tests.

Failures include unregistered later cables, oversized sleeves, missing backing, mixed incompatible products, rigid pipe contact, abandoned open conduits and repairs made without retesting.

Firestop listing and acoustic performance are separate propositions. The installed detail must satisfy both without unsupported substitution.

Worked example 31.25. Penetration open-area fraction

Engineering question. A 150 mm diameter sleeve contains cables occupying 45 per cent of its area; ten per cent of the remaining annulus is visibly unsealed; what fraction of sleeve area is open?

F_o is open fraction, F_c is cable fill fraction, and F_u is the unsealed fraction of the remaining annulus.

Dimensional check. Like counts or like quantities cancel, leaving a dimensionless fraction, percentage, probability or rate normalised to the stated basis.

Engineering interpretation. An open fraction of 5.5 per cent is material for a sensitive boundary and requires correction.

Uncertainty and valid range. Visual estimation of cable fill and void area may be imprecise.

What the calculation does not establish. The fraction does not predict acoustic loss or firestop performance.

31.26 Background sound, masking and operational speech discipline

Background sound influences whether residual speech is audible or intelligible; natural building noise, HVAC and deliberate masking vary spatially and temporally, so the protected condition must be defined by spectrum and state rather than one dBA value.[269]

Masking interacts with vocal effort, listener position, reverberation and door use. Excessive or unstable masking can cause annoyance, encourage louder speech or create quiet zones at boundaries and grilles.

The operating plan should define masking set points, zoning, minimum states, fault alarms, after-hours controls, maintenance access and user actions during failure; briefing discipline should address raised voices, seating, doors and amplified audio.

Evidence includes band spectra, spatial maps, temporal logs, controller configurations, loudspeaker inventories, commissioning records, alarm tests and user instructions.

Failures include relying on daytime HVAC noise, leaving masking under local user control, accepting room averages that conceal quiet points, or treating masking as a substitute for repairing a construction leak.

269 MB-0237. ASTM International, ASTM E2638-24.

Masking can reduce speech consequence under stated conditions. It does not confer security authority or cure vulnerabilities outside the acoustic domain.

Worked example 31.26. Band speech-to-background margin after masking

Engineering question. Residual speech in a band is 28 dB and existing background is 22 dB; a masking adjustment adds 4 dB energetically to the background; what is the new approximate margin if the resulting background is 26 dB?

M is speech-to-background margin, L_s is residual speech, and L_b,new is the adjusted background.

Dimensional check. Logarithmic levels use compatible references, so the reported difference or equivalent level remains in decibels.

Engineering interpretation. The positive two-decibel margin indicates that the band may remain audible and should be evaluated with the complete speech metric and spatial distribution.[270]

Uncertainty and valid range. Masking level and speech vary by position; combined uncertainty may exceed two decibels.

What the calculation does not establish. The calculation does not prove intelligibility, comfort or authority to use the room.

31.27 Audiovisual, teleconference and building-automation interfaces

Audiovisual and building-automation systems introduce microphones, loudspeakers, cameras, sensors, network ports, control processors,

270 MB-0871. International Organization for Standardization, ISO 16283-1:2014.

diagnostic services and concealed cabling. Their physical and digital boundaries may extend far beyond the room.[271]

Automatic gain control, beamforming, echo cancellation, standby modes and remote support can alter acquisition or transmission without visible changes. Ceiling devices and mounts can also create penetrations and structure-borne paths.

The approved configuration should define models, firmware, network segments, credentials, remote access, logging, recording, mute behaviour, emergency override, maintenance mode and prohibited peripherals.

Evidence includes asset inventories, architecture diagrams, configuration exports, firmware hashes, network rules, functional tests, microphone-state verification, support records and change approvals.

Failures include cloud-connected equipment, auto-answer, hidden diagnostic microphones, unsecured maintenance accounts, altered firmware and user-installed devices that bypass the approved baseline.

Acoustic construction cannot compensate for an authorised or compromised electronic path. Cyber and technical-security authorities must own their respective propositions.

Worked example 31.27. Audiovisual state-space count

Engineering question. A room has three microphone modes, two conferencing modes, two recording states and three network-support states. How many simple combinations exist?

271 MB-0342. ASTM International, ASTM E966-18a.

N_s is the number of combinations, and each N term is the count of states for one subsystem.

Dimensional check. Each term uses the units defined for the example, and the final unit follows directly from the stated arithmetic.

Engineering interpretation. Thirty-six combinations illustrate why commissioning should select risk-significant states rather than assume one normal mode represents the system.

Uncertainty and valid range. The count assumes independent combinations and excludes hidden vendor states.

What the calculation does not establish. Not every theoretical state is permitted or technically possible.

31.28 COMSEC authority and secure communications

Communications security protects telecommunications information through authorised measures, material, systems and procedures. It intersects with the room when classified or sensitive speech is carried beyond the physical enclosure.[272]

Secure communications depend upon approved equipment, custody, configuration, key management, installation, user authentication and transmission security. Room acoustics protect the local environment but do not validate the communications chain.

The design should identify the departmental COMSEC authority, approved devices, installation interfaces, storage, access, maintenance, emergency destruction or removal requirements and prohibited unprotected pathways.

272 MB-0816. International Organization for Standardization, ISO 10140-2:2021.

Evidence includes authority correspondence, equipment approvals, custody records, installation acceptance, user briefings and maintenance documentation retained within authorised channels.

Failures include connecting approved devices through unapproved peripherals, exposing secure audio through room loudspeakers, using consumer conferencing as a fallback, or allowing unescorted maintenance near COMSEC material.

This public chapter does not reproduce cryptographic, key-management or controlled installation procedures. It only identifies interfaces that the room project must govern.

Worked example 31.28. Secure communications availability

Engineering question. An approved secure communication service was required for 220 operational hours and available for 214 hours. What was availability?

A_c is availability, T_a is available time, and T_r is required time.

Dimensional check. Counts cancel where divided, while time products or quotients retain hours or months as shown.

Engineering interpretation. Six unavailable hours require fallback restrictions and incident review if protected operations depended upon the service.[273]

Uncertainty and valid range. Time records may not reveal degraded confidentiality or performance while nominally available.

273 MB-0984. JCGM 100:2008.

What the calculation does not establish. Availability is not evidence of cryptographic correctness or COMSEC compliance.

31.29 EMSEC and the protected ITSG-11A boundary

Emission security addresses the risk that unintentional electromagnetic emanations from information technology can be intercepted and exploited; the current Canadian guidance, ITSG-11A, is a protected publication issued under the authority of the Chief, CSE.[274]

The facility problem may involve equipment, cabling, power, grounding, separation, shielding, zoning and the external electromagnetic environment. These mechanisms are not measured by acoustic isolation tests.

The project should identify the departmental COMSEC or EMSEC authority early, restrict controlled design information, coordinate equipment and facility decisions, and preserve evaluation evidence through approved channels.

Public evidence can establish the existence and authority of ITSG-11A, the need for EMSEC posture management and the availability of facility evaluations. Detailed criteria remain protected.

Failures include reconstructing criteria from foreign summaries, assuming distance or shielding values without authority, treating TEMPEST-certified equipment as a complete facility solution, and exposing controlled drawings in ordinary project systems.

This chapter stops at the public boundary. No protected threshold, test procedure or project-specific EMSEC conclusion is stated.

274 MB-0997. JCGM 106:2012.

Figure 31-3. Acoustic, physical, COMSEC, EMSEC, cyber and operational assurance converge upon the authorised room state. Author's original diagram.

Worked example 31.29. Protected-source boundary coverage

Engineering question. A controlled design uses 14 propositions derived from a protected publication; twelve are kept in authorised channels and two appear in an open draft; what is compliant handling coverage?

C_p is compliant handling coverage, N_c is correctly controlled propositions, and N_t is all protected-derived propositions.

Dimensional check. Like counts or like quantities cancel, leaving a dimensionless fraction, percentage, probability or rate normalised to the stated basis.

Engineering interpretation. The two open-draft propositions require immediate containment, assessment and corrective action.

Uncertainty and valid range. Classification and derivation decisions require competent review.

What the calculation does not establish. A percentage does not reduce the seriousness of a single unauthorised disclosure.

31.30 Canadian Industrial TEMPEST Program and facility evaluation

The Canadian Industrial TEMPEST Program certifies qualifying equipment as an EMSEC control and supports Government of Canada departments seeking EMSEC facility evaluations and other controls; equipment certification and facility evaluation are related but distinct.[275]

275 MB-0998. Joint Committee for Guides in Metrology, JCGM GUM-1:2023 and JCGM GUM-6:2020, 2023 and 2020. Status at the 14 August 2026 source freeze: Published and current at source freeze. Public locator: Use is confined to the source scope. The docume.

A compliant product operates within a facility containing power, cabling, interfaces, neighbouring access and other equipment. The whole configuration can create exposure not represented by a product certificate.

Procurement should verify current programme status, certificate scope, product configuration, installation restrictions and authority acceptance. Facility planning should define evaluation timing, access, records and remediation paths.

Evidence includes current certificate records, approved vendor information, equipment identity, configuration baselines, installation records and authorised facility-evaluation reports.

Failures include relying on expired or mismatched certificates, changing components after evaluation, mixing approved and unapproved peripherals, or treating a product certificate as authority to operate the room.

Public CITP information supports programme understanding. Controlled certificate details, methods and facility findings remain subject to authorised distribution.

Table 31-6. Distinct security domains at the secure-room interface

Domain	Principal proposition	Representative evidence	Non-equivalence
Acoustic security	Control of airborne and structure-borne speech transmission	Field measurements, path diagnosis, operating states	Does not validate electronic or electromagnetic paths
Physical security	Control and detection of access to spaces and assets	Zones, barriers, access logs, alarms	Does not prove speech unintelligibility
COMSEC	Protection of telecommunications information	Approved systems, custody and procedures	Does not certify room construction

Domain	Principal proposition	Representative evidence	Non-equivalence
EMSEC / TEMPEST	Control of compromising emanations	Protected guidance, product certificates, facility evaluation	Does not follow from acoustic isolation
Cyber security	Protection of systems, services and data flows	Selected controls, configuration and assessments	Does not establish specialised-facility authority

Worked example 31.30. Facility-evaluation closure ratio

Engineering question. An EMSEC facility evaluation identifies 17 actions. Fifteen are verified closed and two await authority review. What is verified closure?

C_e is evaluation closure, N_v is verified closed actions, and N_a is all actions.

Dimensional check. Like counts or like quantities cancel, leaving a dimensionless fraction, percentage, probability or rate normalised to the stated basis.

Engineering interpretation. Two actions remain open until the authorised evaluator or decision authority accepts the evidence.[276]

Uncertainty and valid range. Closure classification depends on authorised evidence and may change after review.

What the calculation does not establish. The ratio does not disclose controlled findings or permit operation before the authority decision.

276 MB-0999. Joint Committee for Guides in Metrology, JCGM GUM-5:2026, Guide to the expression of uncertainty in measurement.

31.31 Cyber security, physical protection and specified information

Current Cyber Centre publications connect physical protection, access control, media, systems, configuration and assurance; for non-Government systems handling specified information, the applicable control set and assessment methods require explicit contractual and organisational selection.[277]

Room systems can process specified information through conferencing, displays, sensors, logs, access-control platforms and maintenance tools. Physical control of the room does not prove the confidentiality of those systems.

The security plan should identify systems in scope, information flows, responsible officials, selected controls, assessment activities, evidence owners, external services and enduring exceptions.

Evidence includes system security plans, control implementation statements, assessment procedures, test results, plans of action and milestones, inventories and configuration records.

Failures include assuming that building access control satisfies cyber access control, applying a generic control catalogue without tailoring, and omitting specialised devices because they are regarded as building equipment.

ITSP.10.171 and related publications address specified information within their scope. They do not establish classified specialised-facility accreditation.

Table 31-7. Information categories and facility-control implications

277 MB-0908. International Organization for Standardization, ISO 9614-1:1993.

Information context	Representative injury concept	Facility implication	Required caution
Unclassified but sensitive / specified	Contractually or administratively required safeguarding	Selected physical, cyber and operational controls	Do not import US CUI terminology without Canadian mapping
Protected A / B / C	Expected injury increasing by category and context	Screening, need-to-know, site capability and system controls	Exact project classification and contract govern
Classified information	National-interest injury with Confidential, Secret or Top Secret levels	FSC, appropriate personnel, site and specialised controls	Clearance alone does not confer need-to-know
Foreign, NATO or allied material	Release and handling conditions under agreements	Designated-authority and visitor controls	Names and levels are not automatically equivalent

Worked example 31.31. Physical and cyber control coverage

Engineering question. A room system has 28 selected controls, of which 25 have implementation evidence and 21 have completed assurance activities. What is assurance coverage?

C_assur is assurance coverage, N_assessed is controls with completed assurance, and N_selected is selected controls.

Dimensional check. Like counts or like quantities cancel, leaving a dimensionless fraction, percentage, probability or rate normalised to the stated basis.

Engineering interpretation. Implementation evidence without assessment remains an unverified claim for seven controls.

Uncertainty and valid range. Assessment depth and sample quality vary among controls.

What the calculation does not establish. Coverage does not imply every control is effective or that classified-facility requirements are met.

31.32 Supply-chain risk, provenance and approved substitutions

Secure-room components and systems pass through designers, manufacturers, distributors, installers, integrators and maintenance providers. Supply-chain assurance concerns identity, provenance, integrity, authorised substitution and control of sensitive information.[278]

A visually similar product can differ in acoustic performance, firmware, radio capability, materials, fire listing, dimensions or support. Substitution can therefore alter several security propositions simultaneously.

The procurement plan should define approved manufacturers, model numbers, versions, country or source restrictions where authorised, submittal evidence, chain of custody, secure delivery, inspection and change approval.

Evidence includes purchase orders, certificates, serial numbers, photographs, packaging records, firmware or software bills of materials, receipt inspections and deviation decisions.

Failures include unreviewed equal products, counterfeit components, installer-selected sealants, unsupported firmware, unrecorded replacement parts and disposal of packaging or labels before identity is confirmed.

Public guidance supports process design. Specific national-security supply-chain intelligence and restricted vendor decisions remain outside this manuscript.

278 MB-0909. International Organization for Standardization, ISO 9614-2.

Worked example 31.32. Supply-chain screening score

Engineering question. A proposed component has consequence score 5, provenance uncertainty 3 and substitution detectability 2 on project scales where higher detectability reduces risk; calculate a screening score using consequence times uncertainty divided by detectability.

R_sc is supply-chain screening risk, C is consequence, U is provenance uncertainty, and D is detectability.

Dimensional check. Like counts or like quantities cancel, leaving a dimensionless fraction, percentage, probability or rate normalised to the stated basis.

Engineering interpretation. The score supports comparison and indicates that stronger provenance evidence or inspection would reduce the screening value.[279]

Uncertainty and valid range. Ordinal scales and the functional form are project assumptions.

What the calculation does not establish. The score is not intelligence, a legal vendor determination or a Government of Canada threshold.

31.33 Physical-access monitoring, logs and anomaly correlation

Access-control, intrusion, CCTV, visitor and maintenance records can show whether the approved occupancy model remained valid. Their greatest value appears when events are correlated across systems and physical observations.[280]

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279 MB-1052. National Institute of Standards and Technology, NISTIR 8387, Digital Evidence Preservation: Considerations for Evidence Handlers.
280 MB-0248. ASTM International, ASTM E3176-24, ASTM E620-18.

A door forced open, an alarm bypass, a cleaning visit, a network login and a masking fault may be harmless separately but significant together. Time synchronisation and retention therefore affect forensic value.

The monitoring design should define events, clock sources, retention, review frequency, escalation, privacy constraints, access to logs and procedures for preserving evidence after an incident.

Evidence includes access logs, alarm records, visitor books, maintenance tickets, time-source verification, CCTV references, review records and incident case files.

Failures include unsynchronised clocks, logs overwritten before review, shared credentials, unrecorded manual keys, privacy overcollection, and dashboards that show status without preserving underlying events.

Monitoring supports detection and reconstruction. It does not prove that no unauthorised access or listening occurred below the detection capability.

Worked example 31.33. Access anomaly rate

Engineering question. A month contains 12,400 authorised access events and 31 investigated anomalies. What is the observed anomaly rate per thousand events?

r_a is anomaly rate, N_a is anomalies, and N_e is all access events.

Dimensional check. Like counts or like quantities cancel, leaving a dimensionless fraction, percentage, probability or rate normalised to the stated basis.

Engineering interpretation. The rate permits trend comparison after definitions and detection capability are held constant.

Uncertainty and valid range. Detection changes, duplicate alerts and missing manual-key events affect the estimate.

What the calculation does not establish. A low rate does not prove absence of unauthorised access.

31.34 Construction security and controlled design information

Construction security protects sensitive requirements, drawings, access routes, schedules, test data and concealed details while work is planned and executed. Information exposure can create vulnerability even when the finished room performs well.[281]

Digital models, coordination drawings, photographs and issue logs may reveal boundary geometry, weak points and technical systems. Cloud collaboration, personal devices and uncontrolled printing expand the attack surface.

The construction security plan should classify information, define need-to-know, approve platforms, manage exports, control photography, segregate sensitive detail and establish incident response and destruction rules.

Evidence includes information-requirement matrices, access-control lists, issue histories, export logs, watermarking, transmittals, device approvals and records of secure disposal.

Failures include sending complete secure-room details to broad tender lists, leaving marked drawings on site, using personal messaging, publishing progress photographs and retaining sensitive models after project closure.

281 MB-0338. ASTM International, ASTM E90-23.

Security-minded information management reduces exposure but does not replace Canadian classification, departmental handling rules or controlled-project channels.

Worked example 31.34. Sensitive-information exposure index

Engineering question. A digital model is accessible to 42 accounts for 30 days; a revised need-to-know group would contain 18 accounts; what is the reduction in account-days?

ΔE is exposure reduction, N_{old} and N_{new} are account counts, and t is duration.

Dimensional check. Each term uses the units defined for the example, and the final unit follows directly from the stated arithmetic.

Engineering interpretation. Restricting the group eliminates 720 account-days of potential access while preserving the required 18 users.[282]

Uncertainty and valid range. The measure assumes equal access opportunity and does not capture data exports already made.

What the calculation does not establish. Account-days are an exposure indicator, not proof of compromise or classification adequacy.

31.35 Material custody, secure storage and transport

Materials and equipment can be altered, substituted, observed or lost between manufacture and installation. Custody controls should reflect consequence, vulnerability and the ability to detect interference.[283]

282 MB-0278. ASTM International, ASTM E336-25a.
283 MB-0871. International Organization for Standardization, ISO 16283-1:2014.

Critical items may include specialised hardware, access-control components, communications devices, labelled drawings, test media and components whose identity determines the approved configuration.

The logistics plan should identify secure storage, authorised handlers, seals, transport routes, delivery windows, receipt inspection, quarantine, discrepancy response and release to installation.

Evidence includes custody logs, seal numbers, shipping documents, photographs, storage access records, discrepancy reports and signed handover to the installer.

Failures include unattended deliveries, mixed project stock, broken seals accepted without investigation, overnight storage in unapproved areas and components installed before identity verification.

Custody evidence shows control within the recorded chain. It cannot establish the condition of a component before the first verified point or exclude sophisticated tampering beyond the inspection capability.

Worked example 31.35. Custody-chain completion

Engineering question. A critical component passes through seven required custody transfers. Six have matching sender and receiver signatures. What is chain completion?

C_c is custody completion, N_m is matched transfers, and N_t is required transfers.

Dimensional check. Like counts or like quantities cancel, leaving a dimensionless fraction, percentage, probability or rate normalised to the stated basis.

Engineering interpretation. One transfer is unverified and the item should be quarantined or investigated according to the plan.

Uncertainty and valid range. Signatures prove recorded transfer, not absence of tampering between observations.

What the calculation does not establish. The calculation cannot determine component authenticity or integrity by itself.

31.36 Inspection hold points and concealed-work evidence

Concealed conditions determine whether drawings became physical reality. Wall cavities, perimeter joints, resilient supports, sleeves, firestop depth, duct linings and cable routes should be inspected before closure.[284]

A hold point is effective only when work actually stops, the inspector has access and competence, acceptance criteria are defined, and release is documented. Photographs without scale or location can be misleading.

The inspection plan should assign unique locations, required views, measurements, product identity, witness roles, nonconformance procedure and conditions for reinspection.

Evidence includes signed hold-point records, geolocated or indexed photographs, dimensional measurements, product labels, installer qualifications, nonconformance reports and closure authorisation.

Failures include retrospective photographs, duplicate images used for several locations, inaccessible joints, work covered before inspection, and acceptance based solely on contractor certification.

284 MB-0817. International Organization for Standardization, ISO 10140-4:2021.

Inspection improves confidence in observed work. Sampling and visual access leave residual uncertainty that should be recorded and, where material, addressed by testing or controlled opening.

Table 31-8. Representative concealed-work hold points

Hold point	Required observation	Evidence	Release condition
Boundary framing before lining	Continuity, spacing, resilient interfaces and backing	Indexed photographs and measurements	Accepted configuration and closed nonconformance
Penetrations before firestop closure	Sleeve geometry, service fill and separation	Unique penetration record and scaled images	Approved detail confirmed
Firestop and acoustic seal before concealment	Backing, depth, product identity and contact	Product labels, depth checks, photographs	Fire and acoustic propositions both addressed
HVAC route before ceiling closure	Duct lining, silencers, access panels and supports	Route photographs and component identity	Mechanical and acoustic review complete
Final ceiling / floor closure	No unregistered services, complete perimeter and access control	Closure checklist and as-built mark-up	Responsible inspector authorises closure

Figure 31-4. Construction evidence chain from approved detail to as-built record. Author's original diagram.

Worked example 31.36. Hold-point detection probability

Engineering question. A defect is present in 8 per cent of repeated installations; an inspection method detects it with 90 per cent probability when present; what is the probability that a randomly selected installation both contains and reveals the defect?

P_d is joint probability, P_f is defect prevalence, and P_detect is conditional detection probability.

Dimensional check. Like counts or like quantities cancel, leaving a dimensionless fraction, percentage, probability or rate normalised to the stated basis.

Engineering interpretation. The calculation shows that one inspected installation has only a 7.2 per cent chance of displaying the defect even when the process is imperfect.[285]

Uncertainty and valid range. Prevalence and detection probability are estimates and may vary by inspector and condition.

What the calculation does not establish. The result does not determine the sample size required by an authority or eliminate the need for process controls.

31.37 Climate, northern operations and seasonal configuration

Canadian facilities experience wide temperature, humidity, snow, wind and freeze-thaw conditions. Northern and remote sites may also face long logistics chains, limited specialist access and extended periods between maintenance visits.[286]

Thermal movement changes joints and seals; dry winter air can shrink timber and gaskets, while humidity affects porous materials; snow and wind alter exterior background and pressure; mechanical systems can operate in substantially different seasonal modes.

285 MB-0278. ASTM International, ASTM E336-25a.
286 MB-0246. ASTM International, ASTM E2964-26.

The design should identify environmental ranges, seasonal source states, exterior access, snow and ice effects, heating and humidification, remote monitoring, spares and mobilisation time for repair.

Evidence includes climatic design data, material qualifications, environmental logs, seasonal test results, maintenance records and inspections after severe events.

Failures include commissioning only in mild weather, selecting sealants outside their service range, blocking vents with snow, allowing pressure regimes to change in winter and assuming rapid specialist response at a remote site.

Environmental design data supports engineering. It does not replace site observation or seasonal recommissioning where performance is state dependent.

Table 31-9. Environmental and seasonal states for Canadian facilities

State	Potential change	Security consequence	Verification response
Winter design condition	Dry air, contraction, heating maximum, snow and pressure	Seal gaps, altered background, exterior access changes	Cold-season inspection and operational test
Summer humid condition	Expansion, humidity, cooling and condensate	Joint compression, fan modes, moisture effects	Humidity-state inspection and HVAC test
Shoulder season	Low plant operation and open economiser paths	Quiet background and altered duct routes	Low-background measurement
Severe weather / outage	Emergency power, purge, closures and reduced staffing	Changed equipment and listener states	Event procedure and recommissioning trigger
Remote maintenance interval	Delayed repair and limited specialist access	Extended degraded operation	Spares, remote monitoring and restricted-use plan

Worked example 31.37. Seasonal joint movement

Engineering question. A 9 m aluminium frame experiences a 45 °C temperature change. Using coefficient 23×10^{-6}/°C, what is free thermal movement?

ΔL is length change, α is thermal expansion coefficient, L is length, and ΔT is temperature change.

Dimensional check. The thermal coefficient, length and temperature change reduce to a length, reported in metres and millimetres.

Engineering interpretation. Nine millimetres of free movement is large enough to affect seals and interfaces if the detail cannot accommodate it.

Uncertainty and valid range. Restraint, temperature distribution and material properties alter actual movement.

What the calculation does not establish. The simple calculation does not determine joint stress, acoustic leakage or code adequacy.

31.38 Fire safety, accessibility, heritage and legal interfaces

Secure construction remains subject to applicable fire, life-safety, accessibility, structural, heritage, labour and privacy requirements. A security objective cannot justify an unapproved impairment of egress, alarm audibility or inclusive access.[287]

Door closers, seals, vestibules, glazing, wall build-ups, dampers, firestopping, assistive listening and emergency systems can change both security and code propositions. Heritage fabric may constrain irreversible work and conceal unknown paths.

287 MB-0852. International Organization for Standardization, ISO 12999-1:2020.

The coordination process should identify authorities having jurisdiction, adopted code editions, equivalencies, heritage approvals, accessibility requirements and conflict-resolution procedures.

Evidence includes code analyses, permits, professional seals, firestop records, accessibility review, heritage documentation, test reports and approved deviations.

Failures include disabling door hardware to improve sealing, substituting unlisted firestop, blocking alarm devices, creating inaccessible thresholds and damaging heritage fabric without approved intervention.

This chapter provides engineering coordination principles. Legal compliance and authority decisions remain with the applicable federal, provincial, territorial, municipal and heritage bodies.

Worked example 31.38. Coordinated requirement closure

Engineering question. A secure door has five acoustic, six fire, four accessibility and three security requirements. Two requirements overlap across disciplines, leaving 16 unique requirements. Fourteen are verified. What is unique closure?

C_u is unique closure, N_v is verified requirements, and N_u is unique requirements after removing overlap.

Dimensional check. Like counts or like quantities cancel, leaving a dimensionless fraction, percentage, probability or rate normalised to the stated basis.

Engineering interpretation. Two unresolved requirements prevent a complete interdisciplinary conclusion.[288]

Uncertainty and valid range. Determining overlap requires careful requirement mapping.

What the calculation does not establish. The ratio does not permit one discipline to waive another authority's requirement.

31.39 Commissioning matrix and complete-envelope test planning

Commissioning should test the room as an installed and operated system. The matrix links requirements to source states, receiver states, equipment, methods, witnesses, acceptance rules and evidence products.[289]

A complete-envelope plan includes doors, walls, ceilings, floors, HVAC, penetrations, background, masking, communications and adjoining access. It tests normal, quiet, maintenance, emergency and degraded configurations where those states are credible.

The commissioning authority should approve scripts, prerequisites, instrumentation, calibration, data formats, issue management and retest conditions. Each result should identify the exact configuration and operating state.

Evidence includes the commissioning plan, state matrix, checklists, raw measurements, photographs, issue logs, corrective actions, retests and final configuration statement.

288 MB-0342. ASTM International, ASTM E966-18a.
289 MB-0286. ASTM International, ASTM E413-22.

Failures include testing components separately without a whole-room conclusion, omitting low-background states, altering the room between test days, and accepting results without traceable raw data.

Commissioning demonstrates performance under tested conditions. It does not eliminate untested states or replace specialised Canadian accreditation.

Table 31-10. Complete-envelope commissioning state matrix

State	Source condition	Building / system condition	Required evidence
Normal protected meeting	Authorised speech profile	Doors closed, normal HVAC and approved masking	Whole-room acoustic and system functional record
Raised or amplified speech	Maximum authorised source	Conference equipment active	Calibrated source and receiver evidence
Quiet-hour condition	Normal speech	Minimum credible background and night HVAC	Background spectra and local leakage survey
Maintenance condition	Test source	Panels, controls or systems in maintenance state	Restriction verification and restoration record
Emergency / degraded condition	Defined permitted activity	Emergency power, fire or communication mode	Operating limitation and event decision

Worked example 31.39. Commissioning state coverage

Engineering question. A commissioning matrix identifies 64 risk-significant room states; fifty-eight were tested and six were prohibited by operating rules; what proportion has a defined disposition?

C_m is disposition coverage, N_t is tested states, N_p is formally prohibited states, and N_s is all identified states.

Dimensional check. Like counts or like quantities cancel, leaving a dimensionless fraction, percentage, probability or rate normalised to the stated basis.

Engineering interpretation. Every identified state has either test evidence or an enforceable prohibition, although the quality of each disposition still requires review.

Uncertainty and valid range. Undiscovered states and ineffective prohibitions remain residual risks.

What the calculation does not establish. Complete disposition coverage is not authority to operate without formal approval.

31.40 Uncertainty, guard bands and decision rules

Every quantitative acceptance decision contains uncertainty from instruments, calibration, positioning, source variation, background correction, spatial sampling, repeatability and data processing. The decision rule determines how that uncertainty affects pass or fail.[290]

Uncertainty should be expressed through a measurement model with standard components, covariance where relevant and an expanded uncertainty when appropriate. A guard band can reduce false-accept risk but may increase false rejection.

The specification should define the tolerance, measured quantity, uncertainty method, coverage factor, decision rule, rounding and treatment of borderline results before testing begins.

290 MB-0289. ASTM International, ASTM E477.

Evidence includes an uncertainty budget, component estimates, distribution assumptions, sensitivity coefficients, covariance treatment, calculation files and signed decision records.

Failures include subtracting a generic uncertainty value from every result, ignoring correlation, changing the decision rule after seeing data, and reporting excessive significant figures.

Metrology guides structure the decision. The competent authority determines the acceptable risk and applicable limit.

Table 31-11. Illustrative measurement-uncertainty budget

Component	Standard uncertainty	Basis	Correlation note
Calibration	0.6 dB	Certificate and field-check variation	May be common across related channels
Source repeatability	0.7 dB	Repeated source measurements	Can correlate across receiver positions
Position and spatial sampling	0.9 dB	Repeat positioning and spatial variance	Often dominant and not fully independent
Background correction	0.5 dB	Temporal background variation	Depends on source-to-background margin
Processing and rounding	0.2 dB	Software comparison and resolution	Usually small but should remain traceable

Worked example 31.40. Combined standard uncertainty

Engineering question. Independent standard uncertainty components are 0.6 dB for calibration, 0.9 dB for positioning, 0.7 dB for repeatability and 0.5 dB for background correction. What is the combined standard uncertainty?

u_c is combined standard uncertainty and each u term is a standard uncertainty component.

Dimensional check. Logarithmic levels use compatible references, so the reported difference or equivalent level remains in decibels.

Engineering interpretation. With coverage factor two, an illustrative expanded uncertainty is about 2.8 dB.[291]

Uncertainty and valid range. Independence must be justified; covariance can change the result.

What the calculation does not establish. The uncertainty does not supply a tolerance or decision rule.

31.41 Nonconformance, deviation, exception and residual risk

A nonconformance records failure to meet a stated requirement; a deviation concerns an authorised departure during production, while an exception or waiver may permit a condition under defined authority and risk; these terms should not be conflated.[292]

The technical consequence depends upon path dominance and interaction; a small defect can be negligible in one assembly and decisive in another; temporary compensating measures can also create operational burdens and new failure modes.

The issue process should identify requirement, observation, cause, immediate control, technical analysis, corrective action, evidence, authority decision, expiry and verification trigger.

Evidence includes nonconformance reports, photographs, calculations, test data, corrective-work records, risk acceptance and closure signatures.

291 MB-0906. International Organization for Standardization, ISO 7235.
292 MB-0908. International Organization for Standardization, ISO 9614-1:1993.

Failures include relabelling a defect as an as-built condition, accepting undocumented contractor judgement, carrying temporary controls indefinitely and closing issues without verifying the repaired state.

Residual risk belongs to the authorised decision maker. The engineer should quantify and explain evidence but should not silently accept security consequence on behalf of the owner.

Worked example 31.41. Guard-band acceptance decision

Engineering question. A requirement is at least 48 dB; the measured result is 50.3 dB with expanded uncertainty 2.0 dB; a conservative rule accepts only when result minus uncertainty meets the requirement. Does it pass?

L_accept is the guarded value, L_m is measured result, and U is expanded uncertainty.

Dimensional check. Logarithmic levels use compatible references, so the reported difference or equivalent level remains in decibels.

Engineering interpretation. The result passes this stated conservative rule by 0.3 dB.

Uncertainty and valid range. Rounding, uncertainty validity and correlation with the limit must be controlled.

What the calculation does not establish. This illustrative rule is not a Canadian governmental acceptance criterion unless formally adopted.

31.42 Handover, operations baseline and staff competence

Handover transfers a technical configuration into an operational system. The operator needs an accurate baseline, clear restrictions, trained staff, maintenance resources, spares and access to the authority chain.[293]

293 MB-0246. ASTM International, ASTM E2964-26.

Operational competence includes recognising faults, controlling doors and equipment, preserving approved states, reporting incidents, managing visitors and understanding when discussion must stop.

The turnover package should include as-built drawings, asset registers, configuration exports, approved settings, test reports, open conditions, maintenance schedules, training, contact lists and change-control procedures.

Evidence includes signed handover, training attendance, competency checks, operating procedures, spare-part identity and acknowledgement of restrictions.

Failures include incomplete manuals, missing passwords, undocumented controller settings, untrained night staff, unavailable replacement seals and operators unaware that a failed masking or HVAC state changes room use.

Training supports correct operation but cannot substitute for competent technical maintenance or authority decisions after material change.

Worked example 31.42. Competence coverage

Engineering question. A turnover plan identifies 24 role-specific competencies. Twenty-one have trained personnel and observed performance evidence. What is competence coverage?

C_k is competence coverage, N_e is evidenced competencies, and N_r is required competencies.

Dimensional check. Like counts or like quantities cancel, leaving a dimensionless fraction, percentage, probability or rate normalised to the stated basis.

Engineering interpretation. Three competencies require training, reassignment or an operating restriction.[294]

Uncertainty and valid range. Observed performance is a sample and can decay without practice.

What the calculation does not establish. Coverage does not confer security screening, professional licensure or authority delegation.

31.43 Maintenance, incidents and event-driven recommissioning

Secure-room assurance decays when seals wear, filters change, dampers move, software updates, cables are added, neighbouring spaces change or incidents occur. Maintenance and security-event processes should therefore connect to recommissioning triggers.[295]

Event-driven triggers include door replacement, ceiling access, penetration work, HVAC rebalance, water damage, fire response, suspected surveillance, unexplained access, major firmware change and relocation of critical equipment.

The lifecycle plan should define inspection intervals, condition limits, fault response, event classification, evidence preservation, competent review and the scope of targeted or full recommissioning.

Evidence includes maintenance tickets, inspection data, event reports, photographs, configuration comparisons, repair records, retest results and authority notifications.

294 MB-0913. International Organization for Standardization, ISO/IEC 17025:2017.
295 MB-1245. U.S. Department of Defense, UFGS 01 91 00.15, Building Commissioning.

Failures include treating maintenance as like-for-like without verification, deleting logs during incident response, operating through a known defect and testing only the repaired component when collateral changes occurred.

Recommissioning restores evidence for a stated configuration. It does not retroactively prove that the room remained secure during an unverified interval.

Figure 31-5. Lifecycle assurance loop for Canadian secure facilities. Author's original diagram.

Worked example 31.43. Mean time between configuration-affecting events

Engineering question. A room records five configuration-affecting events over 30 months. What is the observed mean interval?

MTBE is mean time between events, T is observation time, and N_e is event count.

Dimensional check. Counts cancel where divided, while time products or quotients retain hours or months as shown.

Engineering interpretation. An average six-month interval supports planning regular configuration review and event-driven recommissioning capacity.

Uncertainty and valid range. Events are sparse and may not follow a stationary process.

What the calculation does not establish. The mean does not predict the next event or indicate that each event caused degradation.

31.44 Multinational, allied and foreign-contract interfaces

Canadian projects can involve NATO, allied, bilateral or foreign information and visitors. The governing agreement, designated security authorities, contract clauses and release restrictions may impose conditions distinct from ordinary domestic practice.[296]

Terminology and clearance levels are not automatically equivalent across countries. Visitor access, discussion content, documents, communications, equipment and facility approvals may require separate confirmation.

The project should identify information ownership, release authority, applicable agreement, host and visitor approvals, escort conditions, permitted systems and records handling.

Evidence includes requests for visit, security-assurance exchanges, contract annexes, release approvals, visitor logs, briefings and records of authorised content.

Failures include assuming reciprocity from similar clearance names, hosting visitors before approval, discussing protected content outside the authorised purpose and using foreign equipment without review.

This chapter does not interpret classified agreements or foreign technical criteria. The designated authorities control the actual interface.

Worked example 31.44. Foreign-interface approval closure

Engineering question. A visit requires host approval, visitor clearance confirmation, release authority, discussion agenda, escort plan and system approval. Five of six are complete. What is closure?

296 MB-1315. Whole Building Design Guide, Public building commissioning resources and current UFGS master.

C_f is foreign-interface closure, N_c is completed approvals, and N_r is required approvals.

Dimensional check. Like counts or like quantities cancel, leaving a dimensionless fraction, percentage, probability or rate normalised to the stated basis.

Engineering interpretation. The missing approval remains a hard gate regardless of the high percentage.[297]

Uncertainty and valid range. Documents may expire or be limited to a different date or purpose.

What the calculation does not establish. The ratio does not establish equivalence of Canadian and foreign clearances.

31.45 Public-source restraint and protected-publication discipline

A technically serious public manuscript must recognise where authoritative Canadian information is protected. The existence, issuer, title, status and public access route can often be stated without revealing substantive controlled content.[298]

Restraint is not an excuse for vague analysis. Public physics, measurement science, governance and interface reasoning can be developed deeply while controlled thresholds, layouts, vulnerabilities and procedures remain excluded.

297 MB-0913. International Organization for Standardization, ISO/IEC 17025:2017.
298 MB-0801. International Electrotechnical Commission, IEC 60942:2017.

The source register should mark access classification, handling channel, authorised users, public propositions and prohibited extrapolations. Drafting and peer review should include a releaseability screen.

Evidence includes source-status records, public locators, classification markings, release decisions, redaction logs and reviewer sign-off.

Failures include reconstructing protected criteria from fragments, citing unofficial copies, converting foreign values into supposed Canadian thresholds and publishing project details that reveal vulnerable geometry.

The strongest defensible public conclusion is often that a competent authority must be consulted. That boundary should be explicit, not disguised as missing research.

Worked example 31.45. Public-source releaseability fraction

Engineering question. A draft contains 160 technical propositions; review classifies 146 as public, nine as requiring redaction and five as requiring controlled-channel handling; what fraction is publicly releasable without change?

F_r is releasable fraction, N_p is public propositions, and N_t is total propositions.

Dimensional check. Like counts or like quantities cancel, leaving a dimensionless fraction, percentage, probability or rate normalised to the stated basis.

Engineering interpretation. Fourteen propositions require action before public release.

Uncertainty and valid range. Releaseability is a competent-authority judgement and can depend on aggregation.

What the calculation does not establish. A numerical fraction does not permit publication of any individual controlled proposition.

31.46 Scientific research collaboration environments and special-purpose spaces

Research facilities, laboratories, medical collaborations and university partnerships can combine protected conversations with open scientific exchange, visiting scholars, specialised instruments and shared infrastructure.[299]

Sensitive speech may occur near vibration-sensitive equipment, gas systems, clean spaces, animal facilities, imaging systems or experimental networks. These constraints can limit construction methods and create unusual service paths.

The operational requirement should separate open, controlled and prohibited activities; identify visitor and data flows; map shared equipment; and define when a special-purpose room requires additional authority.

Evidence includes collaboration agreements, access matrices, equipment inventories, service diagrams, visitor procedures, ethics or privacy approvals and room-use logs.

Failures include discussing controlled topics in an otherwise reputable laboratory, relying on institutional affiliation as a security control, or allowing shared instruments and remote support to bridge the boundary.

299 MB-0807. International Electrotechnical Commission, IEC 61672-3.

Research governance, privacy, ethics and security each have separate authority. No single approval should be represented as satisfying all of them.

Worked example 31.46. Collaboration-access reduction

Engineering question. A research workspace has 62 authorised facility users, but only 14 require access to a protected discussion project. What percentage reduction results from a dedicated need-to-know group?

R_a is access-population reduction, N_p is project users, and N_f is facility users.

Dimensional check. Like counts or like quantities cancel, leaving a dimensionless fraction, percentage, probability or rate normalised to the stated basis.

Engineering interpretation. A dedicated group reduces potential project access by more than three quarters.[300]

Uncertainty and valid range. The calculation assumes the access system enforces the group and ignores visitors or shared-service staff.

What the calculation does not establish. Population reduction does not replace acoustic, cyber or operational controls.

31.47 Alternate work sites, telework and temporary protected discussion

Alternate work sites and telework introduce uncontrolled neighbours, domestic systems, variable background, personal devices and limited

300 MB-0862. International Organization for Standardization, ISO 16063-21:2003.

inspection. A facility zoning guide should not be treated as a telework standard.[301]

Even when electronic access is authorised, the acoustic and visual environment may be unsuitable for protected discussion; headsets reduce loudspeaker exposure but do not control room pickup, household access or remote-service data flows.

Policy should identify permitted information levels, approved locations, technical systems, privacy screen, background conditions, interruption rules, storage, incident reporting and when personnel must return to an approved site.

Evidence includes telework agreements, system approvals, user briefings, site self-assessments where authorised, access logs and incident records.

Failures include discussing sensitive information in shared accommodation, using consumer smart speakers nearby, relying on white noise without measurement and treating temporary convenience as a permanent operating model.

This chapter does not authorise telework or protected discussion at alternate locations. Departmental policy and the responsible security authority control.

Worked example 31.47. Alternate-site suitability score

Engineering question. An authorised checklist has ten mandatory conditions; an alternate site meets seven, can temporarily compensate for one, and fails two; compensated conditions receive weight 0.5; what is the planning score?

301 MB-0278. ASTM International, ASTM E336-25a.

S_a is suitability score, N_m is met conditions, N_c is compensated conditions, and N_t is all conditions.

Dimensional check. Like counts or like quantities cancel, leaving a dimensionless fraction, percentage, probability or rate normalised to the stated basis.

Engineering interpretation. Two failed mandatory conditions should prevent use unless the responsible authority changes the rule or selects another site.

Uncertainty and valid range. Weights are illustrative and may conceal hard gates.

What the calculation does not establish. The score is not an authorisation for telework or protected discussion.

31.48 Decommissioning, sanitisation and record disposition

Decommissioning removes the room from authorised service and controls the information, equipment, records and residual physical features that remain. The process begins before demolition or lease surrender.[302]

Media, controller memory, access logs, recordings, drawings, labels, COMSEC interfaces and specialised equipment may require sanitisation, return, destruction or controlled transfer. Physical alterations can expose concealed details.

The plan should define authority approval, cessation of use, inventory, data sanitisation, equipment disposition, drawing control, contractor access, inspections and final record retention.

302 MB-0871. International Organization for Standardization, ISO 16283-1:2014.

Evidence includes decommissioning approval, inventories, sanitisation certificates, destruction records, equipment returns, photographs and lease or site handback documentation.

Failures include leaving configuration data in controllers, disposing of labelled components through ordinary waste, releasing drawings to new occupants and beginning demolition before sensitive items are removed.

Decommissioning evidence proves recorded actions within scope. It does not erase historic exposure or eliminate records that must be retained under law or policy.

Worked example 31.48. Sanitisation evidence completeness

Engineering question. A decommissioning inventory lists 38 data-bearing or controlled items. Thirty-six have disposition records and two are unlocated. What is evidence completeness?

C_d is disposition completeness, N_r is items with records, and N_t is all controlled items.

Dimensional check. Like counts or like quantities cancel, leaving a dimensionless fraction, percentage, probability or rate normalised to the stated basis.

Engineering interpretation. The two unlocated items remain material exceptions requiring search, incident assessment or authority disposition.[303]

Uncertainty and valid range. Inventory accuracy and hidden storage can affect the denominator.

303 MB-0891. International Organization for Standardization, ISO 3382-2:2008.

What the calculation does not establish. A high percentage does not mitigate the consequence of one uncontrolled item.

31.49 Integrated urban multi-tenant secure-speech case study

A composite case considers a federal programme occupying two floors of a downtown tower, with a proposed protected discussion room beside a shared lift lobby and below another tenant; base-building risers, landlord maintenance and public exterior access complicate the security model.[304]

The initial wall concept performs well in laboratory data, but investigation identifies a shared ceiling plenum, an unlined return-air path, an access-controlled yet quiet office above, cloud-connected conferencing equipment and winter HVAC setback.

The revised design extends the boundary, treats the mechanical route, relocates equipment, establishes landlord access controls, defines night-state restrictions and coordinates acoustic, cyber, physical and EMSEC authorities.

Evidence includes the threat and risk assessment, zoning and listener maps, lease interface schedule, first-of-type inspections, state-based commissioning, configuration records and written use conditions.

The case demonstrates why isolated component ratings and single-state testing can create false confidence. It also shows that governance and operating restrictions can be as important as added construction.

The case is hypothetical and composite. It does not describe an actual Government of Canada facility or disclose protected criteria.

304 MB-0997. JCGM 106:2012.

Worked example 31.49. Dominant-path contribution in a multi-tenant case

Engineering question. Linear receiving contributions are 500 units from the return-air path, 180 from the door, 90 from the ceiling and 30 from other paths; what fraction is attributable to the return-air path?

F_dom is dominant-path fraction, Q_dom is the return-air contribution, and Q_i are all modelled contributions.

Dimensional check. Like counts or like quantities cancel, leaving a dimensionless fraction, percentage, probability or rate normalised to the stated basis.

Engineering interpretation. Treating the return-air route first offers the largest potential reduction, subject to collateral effects.

Uncertainty and valid range. Model separation and intervention uncertainty may be substantial.

What the calculation does not establish. The fraction does not prove causation without controlled measurements or interventions.

31.50 Canadian doctrine synthesis and evidentiary closure

Canadian public doctrine supports a layered model in which government-wide policy, departmental governance, physical zones, industrial-security approvals, specialised-facility accreditation, technical authorities, engineering evidence and lifecycle control remain distinct but coordinated.[305]

The acoustic-security proposition is bounded by source, path, receiver, background, operating state and uncertainty. It cannot be collapsed into a

305 MB-0913. International Organization for Standardization, ISO/IEC 17025:2017.

wall rating, zone label, personnel clearance, IT approval or TEMPEST product certificate.

The principal remaining limitation is institutional: public sources cannot reproduce protected Canadian facility criteria or substitute for actual authority engagement. The chapter therefore states interfaces and boundaries rather than inventing hidden requirements.

Chapter 31 Glossary

The glossary defines terms as used in this chapter. Where a term has a controlling governmental or standards definition, the source and project context govern over this explanatory shorthand.

Accreditation. A formal decision by the responsible authority concerning a defined facility, purpose, configuration and set of conditions.

Authority to operate. Written permission to use a specialised facility or system within stated limits after the required evidence and decisions are complete.

Canadian Industrial TEMPEST Program. Cyber Centre programme that certifies qualifying TEMPEST equipment as an EMSEC control and supports related facility-evaluation activity.

Chief Security Officer. Departmental official responsible for security leadership and management under the applicable delegation and policy instruments.

Compensating measure. A control adopted to reduce risk when a preferred requirement cannot be met, subject to authority review and lifecycle verification.

COMSEC. Measures and authorised systems used to protect telecommunications information, including associated custody and procedural controls.

Configuration baseline. The approved identity, version, setting, geometry and operating state against which later change is assessed.

Construction security. Protection of sensitive project information, materials, access and work processes during design and construction.

Contract Security Program. PSPC programme that administers industrial-security screening, site capabilities, inspections and related contract-security processes.

Controlled area. A space whose access and use are limited under an approved security arrangement. The exact Canadian term and effect depend upon the controlling source.

Decision rule. Documented method for deciding conformity from a measured result, uncertainty and adopted acceptance limit.

Designated organisation screening. Organisation screening supporting protected contract activity within the scope granted by the Contract Security Program.

Document safeguarding capability. Site-specific authority to store, handle and protect stated protected or classified information or assets.

EMSEC. Emission security. Measures addressing the risk of unauthorised interception of compromising electromagnetic emanations.

Evidence map. Register linking a technical proposition to its source, footnote, section and supporting record.

Facility security clearance. Organisation clearance supporting classified contract activity within the scope granted by the Contract Security Program.

Field Industrial Security Officer. Contract Security Program official who performs or coordinates site-security inspection and related advice within the public programme process.

Guard band. Decision margin applied between a measured result and a limit to control conformity risk.

High-security zone. Most restrictive zone in the public RCMP five-zone hierarchy, applied according to threat and risk.

ITSG-11A. Protected Canadian EMSEC guidance that superseded ITSG-11 in March 2025.

Listener-access model. Spatial and temporal representation of people, positions and conditions from which residual speech might be observed.

Need-to-access. Operational requirement for a person to enter a particular space or use a particular asset.

Need-to-know. Requirement that access to sensitive information be necessary for authorised duties in addition to appropriate screening.

Nonconformance. Documented failure to meet a stated requirement, requiring disposition and verification.

Operations zone. Controlled work zone within the RCMP public hierarchy, more restricted than reception but less restricted than security zones.

Protected information. Canadian administrative security category for information whose compromise could reasonably be expected to cause injury outside the national-interest classification framework.

Public zone. Area generally accessible to the public under the public five-zone model.

Reception zone. Controlled transition area between public and more restricted operational spaces.

Recommissioning. Repeat or targeted verification following change, incident, degradation, maintenance or elapsed time.

Request for visit. Contract Security Program process for approving specified visits to secure sites in Canada or abroad.

Residual risk. Risk remaining after controls and corrective actions, accepted or otherwise disposed of by the authorised decision maker.

Security screening. Government process for determining eligibility for access at a stated status or clearance level, distinct from need-to-know.

Security zone. Restricted zone used for sensitive information or assets within the public RCMP hierarchy.

Source freeze. Documented date at which source status, edition and public accessibility are captured for a release.

Specialised secure facility. Public Contract Security Manual category including speech privacy rooms and sensitive compartmented information facilities.

Specified information. Information identified by a Government of Canada authority in a contract as requiring safeguarding under the applicable non-GC system requirements.

Speech privacy room. Specialised secure facility identified in public Canadian contract-security guidance for protecting classified speech beyond ordinary safeguarding capability.

Technical security. Coordinated specialist protection against technical-surveillance and related technical threats under the applicable authority.

Threat and risk assessment. Structured process for identifying assets, threats, vulnerabilities, consequences and appropriate safeguards.

True footnote. A native Word footnote stored in the DOCX footnotes part and linked by an in-text footnote reference.

Uncertainty budget. Structured inventory and combination of measurement-uncertainty components.

Whole-envelope analysis. Assessment of all direct, flanking, service, structural, equipment and operational paths affecting the room.

Zone boundary. Physical and administrative transition between security zones, requiring analysis of access, construction, systems and lifecycle state.

Chapter 32. Comparative Crosswalk, Jurisdictional Differences, and Controlled-Document Boundaries

Multinational acoustic-security work succeeds only when it compares like propositions and refuses false equivalence. Department of State diplomatic doctrine, wider United States Intelligence Community and Department of Defense practice, United Kingdom protective-security and counter-eavesdropping structures, and Canadian departmental, industrial-security and EMSEC systems share important engineering mechanisms, yet they allocate terminology, documents, authority and approval differently.[306]

This chapter therefore treats the crosswalk as a controlled reasoning system. It separates what is physically common from what is institutionally local, distinguishes public evidence from controlled criteria, and states the strongest conclusion supported by each evidence class. A familiar room name, equal numerical rating or allied relationship never substitutes for an authorised applicability decision.

The comparative analysis is confined to public, lawfully accessible, and previously validated author-supplied sources. Controlled, protected, and classified materials may be acknowledged by public title, issuer, status, and institutional role, but concealed thresholds and sensitive procedures are not reconstructed.

306 MB-0984. JCGM 100:2008.

Figure 32-1. Four-jurisdiction comparative architecture linked by a neutral engineering core. Author's original diagram.

32.1 Crosswalk purpose and strict non-equivalence rule

A multinational crosswalk exists to preserve difference while coordinating work. It is not a conversion table that turns one governmental label, approval, rating or document into another.[307]

Department of State treated-conference-room terminology, Intelligence Community SCIF doctrine, British Secure Working Area and Secure Speech Environment descriptions, and Canadian specialised-facility language arise from different authorities and protected functions.

The neutral comparison unit is the bounded proposition: defined source, path, receiver, operating state, consequence, evidence and decision authority. Each jurisdictional term is then attached to that neutral unit without losing its original meaning.

The crosswalk record must identify the source, exact term, institutional owner, purpose, applicability, status, evidence required, decision produced and limitations on reuse.

False equivalence appears when a familiar word or equal-looking number is treated as proof of identical function, performance or authority.

Common physics permits comparison. It does not merge legal authority, protected criteria or authority-to-use decisions.

A defensible crosswalk begins with a proposition, not a room label. Each row should identify the physical object, protected activity, authorised users, adjoining access, operating state, governing source, evidence class, decision

307 MB-0997. JCGM 106:2012.

owner and consequence of failure. Only after those fields match may the reviewer ask whether two requirements are materially comparable. Similarity at one field, such as an identical decibel value, cannot cure a difference in authority, geometry, source state or acceptance rule.

The strict non-equivalence rule should be implemented as a recorded presumption. The default entry is not equivalent until an authorised reviewer demonstrates common scope, method, configuration, uncertainty treatment and legal effect. Where that demonstration cannot be completed because a criterion is controlled, the cell should remain controlled or awaiting authority. It should never be populated by inference from an allied country, a former project or a commercially familiar abbreviation.

Table 32-1. Jurisdictional comparison rule

Field	United States Department of State	Wider United States Government	United Kingdom	Canada
Primary comparison unit	Protected diplomatic function and Department authority	Mission, facility and cognisant security authority	Operational Requirement and departmental protective-security authority	Departmental mission, security policy, zones and Government sponsor
Non-equivalence control	TCR or MTCR is not a generic SCIF	SCIF or SAPF is not a universal secure-room label	Secure Working Area, Secure Room and Secure Speech Environment remain distinct	Speech privacy room and Canadian SCIF remain specialised-facility terms
Shared engineering	Source, path, receiver, state, uncertainty and lifecycle	Same neutral engineering core	Same neutral engineering core	Same neutral engineering core

Worked example 32.1. Crosswalk source coverage

Engineering question. A crosswalk has 160 required cells and 148 contain current primary sources. What is source coverage?

C_s is source coverage, N_v is verified cells, and N_t is required cells.

Dimensional check for crosswalk source coverage: like counts or like quantities cancel, leaving the stated dimensionless fraction, percentage or project screening index.

Engineering interpretation. Twelve cells remain unresolved and must be classified as controlled, awaiting authority, conflicting or genuinely missing.

Uncertainty and valid range. Counting is exact, but the status of a source can change after the freeze date.

What the calculation does not establish. Coverage does not prove correct interpretation or authority acceptance.

32.2 Comparative method and unit of analysis

The comparative method separates institutional doctrine from engineering mechanism, then compares each at the proper scale.[308]

One jurisdiction may organise the problem around a facility type, another around a protected activity, another around zoning, and another around an accrediting authority. Those organisational choices can conceal otherwise similar physical questions.

The chapter uses a source-function-evidence-decision matrix. Every row states what is protected, from whom, under which state, by which mechanism, measured how, and decided by whom.

308 MB-0248. ASTM International, ASTM E3176-24, ASTM E620-18.

Versioned source records, neutral requirement identifiers and jurisdiction-specific overlays allow later correction without rewriting the entire corpus.

A comparison fails when it begins with product names, marketing labels or a single summary rating rather than the protected function and complete path network.

The method supports disciplined coordination, not a universal secure-room standard.

The unit of analysis may be a term, requirement, test, evidentiary record, approval or lifecycle obligation. These units must not be collapsed into a single comparison cell. A test method can be technically similar while its result has a different contractual or governmental effect. Conversely, two approval processes can serve comparable institutional purposes while relying upon dissimilar measurements, witnesses and records. The crosswalk should therefore maintain separate layers and explicit links between them.

A practical comparative method uses a stable identifier for every proposition and records its source text, interpretation, assumptions, conflicts and disposition. The reviewer should be able to move from a narrative conclusion to the exact matrix cell, then to the cited public source or controlled-document reference, and finally to the responsible decision. This chain makes later updates auditable and prevents an elegant summary from concealing missing evidence.

Figure 32-2. Crosswalk method from source through function, evidence and decision. Author's original diagram.

Worked example 32.2. False-equivalence rate

Engineering question. Review finds 9 unsupported equivalence claims among 120 comparison statements. Calculate the rate.

R_e is the false-equivalence rate, N_e is unsupported claims, and N_c is comparison claims.

Dimensional check for false-equivalence rate: like counts or like quantities cancel, leaving the stated dimensionless fraction, percentage or project screening index.

Engineering interpretation. The nine claims require correction because each can misdirect design or approval.[309]

Uncertainty and valid range. Classification depends on an agreed definition of equivalence.

What the calculation does not establish. A low rate does not show that the remaining claims are complete.

32.3 Authority, delegation, and decision ownership

Authority must be traced through the actual institution, delegation and project instrument that governs the room.[310]

The Department of State, an Intelligence Community element, a DoD cognisant security authority, a British departmental security authority and a Canadian Government sponsor can assign different roles to designers, technical specialists, inspectors and approving officials.

309 MB-0871. International Organization for Standardization, ISO 16283-1:2014.
310 MB-0913. International Organization for Standardization, ISO/IEC 17025:2017.

A responsibility matrix should distinguish requirement owner, design authority, construction-security authority, test authority, accrediting or approving authority, operational custodian and change authority.

Evidence includes current delegations, approved plans, named decision owners, meeting records, signed dispositions and an escalation route for unresolved conflicts.

Ambiguous accountability allows technical evidence to accumulate without a person authorised to accept residual risk or grant use.

Consultants and laboratories ordinarily supply evidence. They do not silently inherit governmental authority.

Authority should be traced from the originating statute, policy or departmental instrument through formal delegation to the named role that decides the project question. Consultation, technical review, witnessing and recommendation are separate functions. A multidisciplinary committee may produce excellent analysis without possessing authority to certify, accredit, waive, accept residual risk or authorise use. The responsibility matrix must state these distinctions in verbs that can be tested against the governing instrument.

Delegation records should include effective date, scope, geographical reach, information category, monetary or technical limits, conditions, substitution arrangements and revocation status. A signature is not self-proving if the signer acted outside the delegated scope. The acceptance dossier should therefore preserve the delegation or a verified reference to it, together with the decision, conditions, dissenting technical advice and evidence reviewed.

Table 32-2. Authority and decision ownership crosswalk

Decision	State diplomatic	US IC or DoD	United Kingdom	Canada
Requirement ownership	Department and post mission authorities	Mission owner and cognisant authority	Departmental security authority	Department and Government sponsor
Technical evidence	DS, OBO, specialists and laboratories	AO, SSO, CSA, designers and laboratories as applicable	NPSA, NCSC, UK NACE and departmental specialists as applicable	Department, PSPC CSP, Cyber Centre, RCMP and specialists as applicable
Use decision	Department accreditation or authorised use	Accreditation, reciprocity or programme authorisation	Departmental or competent-authority decision	Accreditation and authority to operate for specialised facilities

Worked example 32.3. Authority closure ratio

Engineering question. Forty-two authority decisions are required and 36 are signed. What is closure?

C_a is authority closure, N_c is closed decisions, and N_r is required decisions.

Dimensional check for authority closure ratio: like counts or like quantities cancel, leaving the stated dimensionless fraction, percentage or project screening index.

Engineering interpretation. Six decisions remain open and can block use even if construction is complete.

Uncertainty and valid range. A signed document may contain conditions that require separate closure.

What the calculation does not establish. The ratio does not confer authority to operate.

32.4 Diplomatic, intelligence, defence, industrial, and civilian scopes

Secure-room work occurs inside overlapping but non-identical mission systems.[311]

Diplomatic facilities abroad operate under Department of State statutory and departmental structures. SCIF and SAPF work engages Intelligence Community or DoD doctrine. Cleared industry follows NISP or national industrial-security processes. Civilian government facilities may use broader protective-security and building standards.

The basis of design must state the mission owner, information category, users, processing or discussion activity, geographic scope, contracting route and competent authority.

The crosswalk should preserve scope exclusions as carefully as inclusions, especially when an authority serves several departments or when one facility houses several missions.

Importing a criterion from a prestigious but inapplicable programme can create cost without authority, while omitting a programme-specific control can invalidate the intended use.

No source is controlling merely because it is more restrictive in one dimension. Applicability precedes severity.

Mission scope determines which protective propositions matter. Diplomatic facilities, intelligence spaces, defence programmes, cleared industrial sites and ordinary federal workplaces can occupy similar construction while presenting different threat actors, information categories, host

311 MB-0801. International Electrotechnical Commission, IEC 60942:2017.

relationships, continuity requirements and investigative authorities. A comparison should identify the mission and protected activity before it compares walls, doors, tests or room names.

Mixed-occupancy projects require more than selecting the most stringent-looking national rule. One suite can contain diplomatic, intelligence, defence, commercial and partner-nation functions whose authorities do not merge. The design should establish a common physical baseline where efficient, then preserve separate overlays, evidence packages and use decisions. Shared construction does not imply shared records, witnesses, release permissions or authority to operate.

Worked example 32.4. Delegation ambiguity index

Engineering question. A responsibility matrix has 55 rows, of which 7 name two accountable officials.

A_d is ambiguity, N_a is ambiguous rows, and N_r is all rows.

Dimensional check for delegation ambiguity index: like counts or like quantities cancel, leaving the stated dimensionless fraction, percentage or project screening index.

Engineering interpretation. The seven rows should be resolved before evidence is produced.[312]

Uncertainty and valid range. Judgement is required where consultation is confused with accountability.

312 MB-0998. Joint Committee for Guides in Metrology, JCGM GUM-1:2023 and JCGM GUM-6:2020, 2023 and 2020. Status at the 14 August 2026 source freeze: Published and current at source freeze. Public locator: Use is confined to the source scope. The docume.

What the calculation does not establish. The index does not establish whether named delegations are legally valid.

32.5 Protected-room terminology and functional descriptions

Room names must be treated as controlled terms, not architectural synonyms.[313]

TCR, MTCR, ACR, SCIF, SAPF, Secure Working Area, Secure Room, Secure Speech Environment, speech privacy room and Canadian SCIF language each carry a particular institutional history and scope.

For coordination, the project should add a neutral functional description stating protected activity, information consequence, source states, equipment, adjoining access and required decision, while retaining the official term in the jurisdictional overlay.

Terminology registers should include issuer, definition, date, status, deprecated forms, permitted abbreviations and prohibited substitutions.

A label can survive after the configuration, authority or function has changed, causing personnel to rely on a name that no longer describes the authorised state.

Neutral descriptions support engineering. They do not replace official names in approvals or records.

Terminology should be managed as a controlled ontology. Every term requires the original wording, issuing organisation, definition, source date, applicable information class, facility function and forbidden substitutions. Acronyms that appear identical can conceal different governance, while

313 MB-1257. U.S. Department of State, 12 FAM 010.

different labels can describe overlapping physical purposes. The glossary should therefore support navigation without declaring legal or technical equivalence.

Specifications and reports should retain the originating jurisdiction's term when it carries authority. A neutral project descriptor may be added in brackets, but it should not replace the official label. When a contractor, designer or translator proposes a familiar substitute, the terminology register should record whether the substitution is accepted for communication only, accepted for technical comparison, or prohibited because it changes scope or decision ownership.

Table 32-3. Protected-room terminology register

Term	Jurisdiction	Protected function	Do not infer
TCR or MTCR	Department of State	Acoustic and electromagnetic protection for defined conference use	Automatic equivalence to SCIF or allied room
SCIF	US Intelligence Community	SCI processing, storage or discussion under ICD 705 structure	One universal construction or acoustic criterion
Secure Working Area	United Kingdom	Work with sensitive information or assets	Secure speech approval
Secure Room	United Kingdom	Storage-focused protected room	Secure Working Area or speech environment
Speech privacy room	Canada	Specialised facility for classified speech	Ordinary document safeguarding capability

Worked example 32.5. Terminology collision fraction

Engineering question. Eighteen of 90 project terms have different controlling meanings across jurisdictions.

F_t is collision fraction, N_c is colliding terms, and N_t is terms reviewed.

Dimensional check for terminology collision fraction: like counts or like quantities cancel, leaving the stated dimensionless fraction, percentage or project screening index.

Engineering interpretation. One fifth of the vocabulary needs jurisdictional qualification.

Uncertainty and valid range. Some differences are contextual rather than absolute.

What the calculation does not establish. The calculation does not produce authorised translations.

32.6 Information categories and consequence language

Classification and protection categories shape access, handling, discussion and facility requirements, but categories do not translate automatically across countries.[314]

United States national security information and SCI, United Kingdom government classifications, and Canadian protected or classified information use different legal and administrative structures.

The engineering team should receive a consequence statement and authorised handling rules rather than infer room requirements from a superficially similar word such as Secret.

The crosswalk should record originating authority, marking, releasability, dissemination controls, retention, transfer and destruction requirements.

An erroneous translation can either expose information or impose controls that the receiving organisation cannot lawfully administer.

314 MB-1261. U.S. Department of State, 12 FAM 510.

Only the originating and receiving authorities can determine release and handling. The engineering chapter records interfaces, not equivalence.

Information categories must be compared by consequence and handling obligations rather than by colour, capitalisation or apparent rank. Relevant fields include originator, damage rationale, dissemination, citizenship or nationality restrictions, need-to-know, storage, discussion, transmission, reproduction, retention, destruction and incident reporting. A category may have no one-to-one foreign counterpart, and a project should be able to operate safely despite that absence.

The facility requirement should be derived from an authorised protection statement that translates the information consequence into engineering and operational propositions. The statement should identify what may be spoken, displayed, processed or stored; who may be present; what adjoining access is credible; and which authority resolves ambiguity. Engineers should not reverse-engineer classification policy from a room rating or infer releasability from physical colocation.

Table 32-4. Information categories and release controls

Comparison field	United States	United Kingdom	Canada	Crosswalk rule
Category source	Executive, statutory and agency policy	Government Security Classifications Policy and departmental rules	Treasury Board and departmental policy	Retain original marking and authority
Need-to-know	Separate from clearance	Separate from personnel eligibility	Separate from screening	Map person, purpose, time and information
International release	Originator and dissemination controls	Government and departmental release controls	Government and departmental release controls	No lexical equivalence authorises transfer

Worked example 32.6. Classification mapping confidence

Engineering question. A mapping uses four independent criteria scored 0.9, 0.8, 0.7 and 0.9. What is the mean confidence?

C_m is mean confidence, c_i are criterion scores, and n is four.

Dimensional check for classification mapping confidence: like counts or like quantities cancel, leaving the stated dimensionless fraction, percentage or project screening index.

Engineering interpretation. The mapping is moderately strong but should retain the lowest-scoring uncertainty.[315]

Uncertainty and valid range. Scores are judgemental and correlated.

What the calculation does not establish. A confidence score cannot authorise cross-national release.

32.7 Personnel screening, clearance, need-to-know, and physical access

Personnel eligibility, need-to-know and physical access are separate controls in every mature system.[316]

A clearance or screening status may be recognised differently across departments and countries, while local access lists, escort rules and mission need remain project specific.

315 MB-1263. U.S. Department of State, 12 FAM 710.
316 MB-1291. U.S. Department of State, Public definitions and descriptions of Acoustic Conference Room, Treated Conference Room and Modular Treated Conference Room.

Access design should map who can approach each boundary, enter service spaces, maintain equipment, review drawings, witness tests and retrieve records.

Evidence includes current screening, need-to-know approval, access groups, visitor records, escort plans, after-hours rules and termination procedures.

Treating clearance as universal access expands exposure and obscures responsibility for maintenance personnel, landlords and temporary workers.

Personnel status does not prove that a room is technically suitable, and room approval does not grant a person access.

Personnel eligibility, clearance, screening, need-to-know and physical access form a sequence of distinct controls. Eligibility may permit consideration for access without granting entry to a room or access to every discussion held there. The crosswalk should record the decision owner, sponsoring organisation, identity assurance, escort condition, visitor procedure, after-hours rules and the system that produces the authoritative access record.

Construction and maintenance populations require particular care because they can enter cavities, plant spaces and service routes that remain outside ordinary user access. The design record should distinguish supervised work, unescorted access, access to controlled drawings, access to test data and access to operational information. A contractor authorised to install a component is not thereby authorised to receive the complete vulnerability model or attend acceptance discussions.

Worked example 32.7. Effective personnel access

Engineering question. Fifty people have facility access, 44 are screened and 37 also have current need-to-know.

C_p is effective authorised coverage, N_b is people meeting both conditions, and N_f is facility-access holders.

Dimensional check for effective personnel access: like counts or like quantities cancel, leaving the stated dimensionless fraction, percentage or project screening index.

Engineering interpretation. Thirteen access records need review or narrower permissions.

Uncertainty and valid range. Records can change between extract and physical audit.

What the calculation does not establish. The result does not prove correct behaviour or room performance.

32.8 Facility approval, certification, accreditation, and authority to operate

Project certification, technical acceptance, accreditation and authority to use must be represented as different decisions.[317]

Department of State certification and accreditation, IC SCIF accreditation and reciprocity, British departmental or technical-security acceptance, and Canadian specialised-facility accreditation use distinct records and authorities.

The decision chain should identify prerequisites, evidence owner, review sequence, conditions, expiry or review triggers, and the exact activity permitted after approval.

317 MB-1261. U.S. Department of State, 12 FAM 510.

A decision register should preserve signed records, conditions, exceptions, unresolved findings, configuration identifiers and superseded dispositions.

A technically strong room can remain unauthorised, while an authorised room can later become nonconforming through change.

Percent completion, consultant opinion and favourable test data do not substitute for the required governmental decision.

Facility status should be represented as a lifecycle state machine rather than a single pass or fail label. Planning acceptance, design approval, construction authorisation, certification of work, technical inspection, accreditation, authority to operate, conditional use, suspension and decommissioning can have different owners and prerequisites. The crosswalk should show which transitions exist in each jurisdiction and which records permit movement between them.

Conditions attached to a decision must remain live configuration obligations. A room may be usable only with defined masking, plant operation, access restrictions, temporary barriers, monitoring or repair dates. The approval register should link every condition to an owner, verification method, expiry or review trigger and consequence of non-compliance. Removing the condition from the summary while retaining only the word approved creates a dangerous false state.

Table 32-5. Decision-type separation

Decision type	Typical evidence	Result	Non-substitution rule
Contractual acceptance	Submittals, inspections, tests	Work accepted under contract	Not accreditation
Technical acceptance	Specialist review and test evidence	Technical finding or recommendation	Not authority to use

Decision type	Typical evidence	Result	Non-substitution rule
Certification	Programme-defined evidence	Certification decision	Scope depends on programme
Accreditation	Complete facility evidence and authority review	Facility approved within conditions	Not permanent after material change
Authority to operate or use	Accreditation plus mission and operating conditions	Permitted activity	Cannot be inferred from percentage completion

Worked example 32.8. Decision-chain latency

Engineering question. Five sequential reviews take 4, 6, 3, 8 and 5 working days. What is total nominal latency?

T_d is nominal decision latency and t_i are review durations.

Dimensional check for decision-chain latency: time differences and sums retain the stated time unit, while ratios of like times are dimensionless.

Engineering interpretation. The programme should schedule at least 26 working days without overlap.[318]

Uncertainty and valid range. Rework and queueing can increase elapsed time.

What the calculation does not establish. The sum is not a service commitment from any authority.

32.9 Source hierarchy and legal effect

Crosswalk reliability depends upon recognising the legal and institutional effect of each source.[319]

318 MB-1263. U.S. Department of State, 12 FAM 710.
319 MB-1267. U.S. Department of State, Bureau of Overseas Buildings Operations, Public mission and project-delivery information.

Law, regulation, executive policy, departmental directive, technical specification, contract clause, guidance page and authority disposition do not occupy the same level.

Each source row should state issuer, identifier, edition, date, status, jurisdiction, mandatory or advisory effect, project incorporation route and controlled-access condition.

Persistent copies, access dates, checksums and supersession history should be preserved where lawful.

A current website can describe a programme while omitting the operative project criteria, and an obsolete manual can remain widely copied after replacement.

Editorial preference cannot resolve a hierarchy conflict. The competent authority must decide applicability and precedence.

Source hierarchy should distinguish binding law, mandatory policy, contractual requirements, competent-authority direction, consensus methods, recognised guidance, manufacturer evidence and project analysis. The hierarchy is contextual. A consensus standard may control a contractually specified measurement while remaining incapable of granting governmental accreditation. A departmental instruction may govern the decision even where a different engineering method appears more precise.

Conflicts should be resolved by applicability and authority, not by publication date alone. The source register should retain edition, amendment, transition, cancellation, supersession, jurisdiction, incorporation route and project decision. When an inaccessible controlled document is known to govern, the public-source chapter should mark the boundary and obtain an authority answer. It should not fill the gap with the nearest public standard.

Table 32-6. Source hierarchy and status fields

Field	Required content	Reason
Authority	Issuer and delegated owner	Determines who may interpret and decide
Instrument class	Law, regulation, policy, standard, contract, guidance or disposition	Prevents equal treatment of unequal sources
Version	Identifier, edition, date and changes	Controls technical applicability
Access	Public, internal, controlled, protected or classified	Controls distribution and inference
Status	Current, superseded, draft, historical or withdrawn	Prevents stale requirements

Worked example 32.9. Source age indicator

Engineering question. A controlling source was issued 5.5 years before the freeze date. What is its age?

A_s is source age, t_f is freeze date, and t_i is issue date.

Dimensional check for source age indicator: time differences and sums retain the stated time unit, while ratios of like times are dimensionless.

Engineering interpretation. Age prompts status verification but does not by itself show obsolescence.

Uncertainty and valid range. Dates can be obscured by amendments and web updates.

What the calculation does not establish. A newer source is not automatically controlling.

32.10 Public, protected, controlled, and classified documents

Document accessibility is itself a design constraint in multinational work.[320]

Public sources can explain roles and methods, while protected or controlled sources may contain operative details that cannot be distributed to the entire team.

The project should use a neutral main register linked to controlled annexes, with stable identifiers that reveal neither hidden thresholds nor exploitable details.

Access control, encryption, approved repositories, extraction rules, translation controls, audit logs, retention and incident response must be defined before information is exchanged.

A blank field can be misread as missing rather than controlled, or a copied excerpt can lose its caveat and circulate beyond authorised recipients.

Acknowledging a controlled document does not authorise reconstruction of its contents.

Controlled-document handling should apply data minimisation from the outset. The open project record may contain a requirement identifier, accountable authority, affected interface, status and verification event without reproducing the protected threshold or vulnerability. The detailed criterion can remain in an access-controlled annex whose release, storage, copying and destruction follow the originator's rules.

Redaction must preserve meaning without exposing sensitive detail. A blacked-out number accompanied by an unredacted calculation, drawing scale or pass statement can disclose the same information indirectly. The

320 MB-1238. U.S. Department of Defense, UFC 4-010-05.

release review should inspect tables, equations, metadata, comments, filenames, image layers, revision histories and cross-references. Public and partner versions should be generated from a controlled source, not edited independently until their relationship is lost.

Table 32-7. Controlled-document handling states

State	Meaning	Permitted crosswalk action
Public	Lawfully accessible to project users	Summarise with source and limitation
Internal	Organisation-controlled but releasable within approved group	Reference through controlled repository
Protected or controlled	Access limited by authority	Use neutral identifier and controlled annex
Classified	National-security controls apply	No public reconstruction or unauthorised extract
Unavailable	Source known but not accessible to reviewer	Mark unresolved and refer to authority

Worked example 32.10. Controlled-document minimisation

Engineering question. A design team has 60 members, but only 14 require a controlled annex. What percentage can be excluded from access?

M_d is minimisation fraction, N_r is recipients requiring access, and N_t is team size.

Dimensional check for controlled-document minimisation: like counts or like quantities cancel, leaving the stated dimensionless fraction, percentage or project screening index.

Engineering interpretation. Controlled distribution can be reduced by more than three quarters.[321]

321 MB-1257. U.S. Department of State, 12 FAM 010.

Uncertainty and valid range. Need can change by phase and task.

What the calculation does not establish. Minimisation does not determine classification or release authority.

32.11 Neutral engineering core and jurisdictional overlays

The common core comprises physical mechanisms and metrology that remain valid across jurisdictions.[322]

Mass, stiffness, damping, leakage, flanking, source spectrum, receiver background, listener access, uncertainty and operating state do not change nationality, but acceptance criteria and official records do.

A neutral core should specify source-state matrices, three-dimensional path maps, band-resolved calculations, workmanship controls, field tests, uncertainty and change management.

Jurisdictional overlays should add official terms, criteria, controlled references, forms, witnesses, decision authorities and record-handling rules.

A merged document becomes dangerous when a local overlay is silently treated as universal or when common engineering is duplicated inconsistently in several annexes.

Physics can be shared. Governmental authority and protected thresholds remain local.

The neutral engineering core should contain mechanisms that remain valid across authorities: source definition, path inventory, receiving geometry, state control, calibration, uncertainty, raw-data preservation, change management and bounded inference. It should not contain invented

322 MB-1263. U.S. Department of State, 12 FAM 710.

universal thresholds. This separation allows substantial technical reuse while leaving national terminology, witnesses, decision rules and approval effects in their proper overlays.

Overlay management requires traceability in both directions. Every local requirement should point to the common process or detail it modifies, and every common element should list the jurisdictions that accept, supplement or reject it. A change to the neutral core should therefore trigger impact review across all overlays. A local exception should remain local unless each other authority affirmatively adopts it.

Figure 32-3. Neutral engineering core with four jurisdictional overlays. Author's original diagram.

Worked example 32.11. Neutral-core reuse

Engineering question. A project has 80 engineering requirements. Sixty-two are common and 18 are jurisdiction-specific.

F_n is neutral-core fraction, N_c is common requirements, and N_t is total requirements.

Dimensional check for neutral-core reuse: like counts or like quantities cancel, leaving the stated dimensionless fraction, percentage or project screening index.

Engineering interpretation. Most engineering can be shared while authority overlays remain distinct.

Uncertainty and valid range. Classification of common versus local requires expert review.

What the calculation does not establish. The fraction does not make local criteria interchangeable.

32.12 Operational requirement and basis of design

Every crosswalk should begin with an operational requirement rather than a preferred product or room type.[323]

NPSA explicitly emphasises an Operational Requirement, while United States and Canadian systems likewise require mission, risk and authority inputs even where the document names differ.

The basis of design should state protected conversations, occupancy, duration, equipment, adjoining spaces, source states, emergency modes, maintenance access and evidence required at handover.

Requirement identifiers should remain stable across drawings, specifications, tests and approvals, with jurisdictional attributes attached rather than buried in prose.

Vague requirements such as secure, soundproof or compliant prevent objective design and allow different parties to assume different authorities.

The operational requirement is a project control document. It is not itself an accreditation.

The operational requirement should state the protected activity in observable terms. It should identify participants, information categories, normal and exceptional speech levels, electronic systems, schedules, adjoining access, expected service life, emergency states, maintenance arrangements and acceptable residual risk. A design brief that merely requests a secure room leaves critical assumptions to suppliers and makes later acceptance arbitrary.

323 MB-1238. U.S. Department of Defense, UFC 4-010-05.

The basis of design should convert the operational requirement into coordinated engineering propositions and verification routes. Every proposition needs a source, owner, design response, evidence type and acceptance decision. Where one national overlay cannot be released to the full team, the basis should expose enough interface information to prevent incompatible work while placing the sensitive detail in an authorised annex.

Worked example 32.12. Requirement completeness

Engineering question. A basis of design contains 72 required fields and 68 are complete.

C_r is requirement completeness.

Dimensional check for requirement completeness: like counts or like quantities cancel, leaving the stated dimensionless fraction, percentage or project screening index.

Engineering interpretation. Four fields must be resolved before procurement.[324]

Uncertainty and valid range. A completed field may still contain poor assumptions.

What the calculation does not establish. Completeness does not equal approval.

32.13 Threat and risk assessment methods

Risk methods differ in institutional form, but all require explicit assets, threats, vulnerabilities, consequences and assumptions.[325]

324 MB-0230. ASTM International, ASTM E2638-24, ASTM E336-25a.
325 MB-1257. U.S. Department of State, 12 FAM 010.

Diplomatic, intelligence, defence, British protective-security and Canadian departmental frameworks may use different threat owners and risk-acceptance processes.

The acoustic model should include authorised speakers, plausible listeners, access duration, equipment states, environmental conditions and non-acoustic surveillance paths.

The risk register should record source provenance, uncertainty, scenario owner, control owner, review date and residual-risk decision.

A generic threat score can hide a high-consequence low-frequency or short-duration exposure, particularly in leased and mixed-use buildings.

Risk ranking supports decisions. It does not create a governmental acceptance threshold.

Risk methods should preserve threat, vulnerability, consequence and uncertainty as separate variables. Jurisdictions can use different scales or formal processes, but the project still needs to know which adversary access, listening opportunity, technical capability, insider action, construction defect or operational failure is being considered. Multiplying unqualified ordinal labels can create numerical precision without analytical clarity.

The comparative register should record the risk authority, assessment date, scenario, assumptions, evidence, confidence, treatment, residual risk and review trigger. A threat assessment may be controlled even when the resulting engineering action is releasable. In that case the public work package should state the required control and authority reference without revealing the intelligence or vulnerability that produced it.

Table 32-8. Threat and risk assumption register

Assumption	Evidence owner	Validation method	Change trigger
Protected activity	Mission owner	Approved operational requirement	Mission or information change
Listener access	Security authority	Access map and observation	Tenancy, route or schedule change
Source states	Operator and acoustical engineer	Calibrated state matrix	Equipment or use change
Technical surveillance threat	Competent technical-security authority	Controlled assessment	Threat or facility change
Residual risk	Authorised risk owner	Signed disposition	Control degradation or incident

Worked example 32.13. Risk screening score

Engineering question. Likelihood is 3, consequence is 5 and exposure is 4 on project scales.

R is a screening score and L, C and E are ordinal ratings.

Dimensional check for risk screening score: like counts or like quantities cancel, leaving the stated dimensionless fraction, percentage or project screening index.

Engineering interpretation. The scenario ranks high relative to lower scores using the same scheme.

Uncertainty and valid range. Ordinal multiplication is a management convention.

What the calculation does not establish. The score is not probability or governmental acceptance.

32.14 Source-state definition

Protected speech varies with voice, language, distance, orientation, room use, conferencing equipment and operational discipline.[326]

Jurisdictional doctrine may prescribe different test sources or security states, but the engineering need for reproducible source definition is common.

The matrix should include ordinary speech, raised voice, amplified playback, conferencing loudspeakers, emergency announcements, maintenance tests and credible failure modes.

Each state needs level, spectrum, directivity, position, duty cycle, duration, control setting and authorisation status.

Testing only a convenient source can miss high-consequence digits, names or commands and can understate amplified or after-hours conditions.

A source state supports only the conditions represented. It does not prove universal privacy.

Source state includes level, spectrum, directivity, position, duration, duty cycle, language, content type and electronic reproduction. A room tested with steady pink noise is not automatically characterised for a live talker, ceiling loudspeaker, conference system or raised-voice emergency. The crosswalk should identify which source states each jurisdiction or project decision requires and which remain untested.

A source-state matrix should also include degraded and abnormal conditions. Microphone automatic gain, loudspeaker equalisation, open doors, disabled masking, night ventilation, backup power and maintenance

326 MB-1291. U.S. Department of State, Public definitions and descriptions of Acoustic Conference Room, Treated Conference Room and Modular Treated Conference Room.

bypasses can materially change exposure. Acceptance should either test these states, prohibit them through enforceable controls, or record the residual risk. An assumed state that cannot be sustained operationally is not a valid design control.

Worked example 32.14. Source-state coverage

Engineering question. A matrix lists 24 credible source states and 19 are tested.

C_x is tested-state coverage.

Dimensional check for source-state coverage: like counts or like quantities cancel, leaving the stated dimensionless fraction, percentage or project screening index.

Engineering interpretation. Five states require test, justified exclusion or operating restriction.[327]

Uncertainty and valid range. The state list may omit unknown software behaviours.

What the calculation does not establish. Coverage does not prove every state passes.

32.15 Listener-access and adjoining-space assumptions

The receiving side of the problem is defined by who can listen, where, when and with what assistance.[328]

Department of State overseas compounds, SCIFs in shared buildings, British secure areas and Canadian zoned facilities can present different adjoining-access models.

327 MB-0230. ASTM International, ASTM E2638-24, ASTM E336-25a.
328 MB-0885. International Organization for Standardization, ISO 19650-5:2020.

The project should map corridors, offices, plant rooms, roofs, façades, floor voids, ceiling plenums, neighbouring tenancies and public exterior positions.

Records should identify access authority, occupancy schedule, quiet states, maintenance windows and changes in tenancy or ownership.

A high room-average result can coexist with a local leak at a position available to an unauthorised listener.

Access assumptions are security inputs and must be approved, not invented by the acoustic consultant.

Listener access is a geometric and temporal proposition. The nearest credible listener may be in a corridor, adjacent office, ceiling void, plant room, roof, façade access system, service riser or temporarily occupied construction area. The assessment should map authorised and unauthorised access, dwell time, concealment, hearing opportunity and the ability to place equipment, while avoiding unnecessary disclosure of exploitable locations.

Adjoining-space assumptions should be tied to enforceable control. If security depends upon a room remaining unoccupied, the dossier should identify who controls it, how access is monitored, how exceptions are approved and what happens when the tenancy changes. A lease clause or local custom is weak evidence unless it produces an observable, maintained and auditable condition throughout the protected room's life.

Worked example 32.15. Time-weighted listener exposure

Engineering question. A corridor is accessible for 12 hours at weight 1, and a quiet plant room for 2 hours at weight 5.

E_w is weighted exposure, t_i is time, and w_i is opportunity weight.

Dimensional check for time-weighted listener exposure: time differences and sums retain the stated time unit, while ratios of like times are dimensionless.

Engineering interpretation. The plant room contributes nearly half the index despite short access.

Uncertainty and valid range. Weights are judgemental.

What the calculation does not establish. Weighted hours are not a probability of recovery.

32.16 Laboratory assembly evidence

Laboratory tests characterise a defined specimen under controlled conditions.[329]

Jurisdictions may reference ASTM, ISO or proprietary methods, but none converts specimen performance directly into facility approval.

Submittal review should compare layers, dimensions, framing, joints, seals, glazing, hardware, penetrations and test configuration with the proposed installation.

The evidence record needs the full report, laboratory competence, specimen description, frequency data, uncertainty where available and known deviations.

Headline STC or Rw values can conceal low-frequency weakness, specimen differences and untested interfaces.

329 MB-1267. U.S. Department of State, Bureau of Overseas Buildings Operations, Public mission and project-delivery information.

Laboratory evidence informs design. Installed performance and governmental decisions require separate evidence.

Laboratory evidence describes a specimen under prescribed mounting, boundary and measurement conditions. The comparative review should retain specimen dimensions, materials, framing, fasteners, joints, seals, openings, environmental conditioning, source rooms, receiving rooms, frequency range and uncertainty. A headline rating stripped from this configuration cannot reliably predict a different construction.

Cross-jurisdictional use of laboratory data requires a method bridge. The bridge should compare measurands, frequency bands, averaging, normalisation, specimen area, flanking suppression, background correction, reporting and classification rules. Where complete raw data are available, the project may recalculate a permitted descriptor. Where only a single rating is available, the limitation should remain explicit rather than being hidden by a converted label.

Worked example 32.16. Laboratory similarity score

Engineering question. Ten critical specimen attributes are compared and eight match the proposed assembly.

S_l is similarity and N_m is matched attributes.

Dimensional check for laboratory similarity score: like counts or like quantities cancel, leaving the stated dimensionless fraction, percentage or project screening index.

Engineering interpretation. Two mismatches require engineering analysis or different evidence.[330]

330 MB-1238. U.S. Department of Defense, UFC 4-010-05.

Uncertainty and valid range. Attributes may not have equal importance.

What the calculation does not establish. An 80 per cent score cannot validate a substitution.

32.17 Installed field performance

Field measurement addresses the configured relationship between source and receiving spaces under stated conditions.[331]

Method names, normalisations, frequency ranges and summary ratings differ among ASTM, ISO and controlled governmental procedures.

The test plan should define room states, positions, backgrounds, doors, HVAC, masking, equipment, calibration, dynamic range and decision rule before measurement.

Raw spectra, decay data, calibration checks, coordinates, photographs and configuration records must be retained.

A passing average can conceal a local path, and an apparently poor result can be limited by background or measurement range.

Field data support the measured state only. They do not grant accreditation or prove protection against non-acoustic threats.

Installed field performance includes workmanship, junctions, doors, glazing, penetrations, structure, plant, room absorption, background and uncontrolled flanking. The result belongs to the tested room pair and state. The crosswalk should not treat it as a material property or assume it applies to every adjoining zone, source position or operating condition.

331 MB-0885. International Organization for Standardization, ISO 19650-5:2020.

Field acceptance should preserve room geometry, source and microphone positions, door state, plant state, background, decay, calibration, raw spectra, exclusions and uncertainty. Repeated measurements at strategically different positions can reveal local weaknesses that a room average conceals. A jurisdictional overlay may require different witnesses or decision rules even when the physical measurements are shared.

Worked example 32.17. Field dynamic-range margin

Engineering question. Measured receiving level is 32 dB and background is 27 dB.

ΔL is measured-to-background separation.

Dimensional check for field dynamic-range margin: logarithmic quantities use compatible references, so subtraction remains in decibels and energetic combinations are applied only where stated.

Engineering interpretation. Background materially influences the result and method limits must be applied.

Uncertainty and valid range. Both levels carry repeatability and temporal uncertainty.

What the calculation does not establish. Simple dB subtraction is not energetic background correction.

32.18 Speech audibility, intelligibility, and privacy

Audibility, intelligibility and closed-room privacy are related but distinct outcomes.[332]

332 MB-1251. U.S. Department of Defense, UFGS public quality-control, photographic-documentation and closeout sections.

A jurisdiction may use a controlled method, a public privacy metric or authority judgement, while another may not publish its acceptance criterion.

The assessment should state speech corpus, language, source level, background, listener model, repetition, high-consequence fragments and uncertainty.

Evidence should preserve band margins, STI or other metric inputs, listener results if used, and the exact inferential statement.

A speech result can be overclaimed as zero intelligibility, or an insulation rating can be mistaken for a listener outcome.

No public metric should be presented as a hidden governmental threshold.

Audibility, intelligibility and privacy answer different questions. A listener may detect speech rhythm without recovering words, recover isolated digits without understanding conversation, or accumulate meaning through repeated exposure. The assessment should identify the speech corpus, language, talker distribution, listener model, background, exposure time and consequence of partial recovery.

Privacy metrics should be treated as probabilistic evidence rather than an absolute promise of silence. The report should state confidence, variability, tested population, untested languages, assistive devices, electronic enhancement and high-consequence content. A favourable index does not prove that no person, sensor or recording process can recover useful information, and it does not itself confer governmental approval.

Worked example 32.18. Speech-to-background margin

Engineering question. Residual speech is 24 dB and receiving background is 29 dB in one band.

M_sb is the band speech-to-background margin.

Dimensional check for speech-to-background margin: logarithmic quantities use compatible references, so subtraction remains in decibels and energetic combinations are applied only where stated.

Engineering interpretation. The negative margin reduces audibility in that band.[333]

Uncertainty and valid range. Other bands, repetition and listener acuity remain uncertain.

What the calculation does not establish. The result does not prove zero intelligibility.

32.19 Metrics and rating-system collisions

Equal-looking numbers can arise from different measurands, procedures, corrections and rating rules.[334]

STC, ASTC, NIC, Rw, DnT,w, DnT,A, STI and closed-room privacy quantities cannot be translated by label substitution.

The crosswalk should record the full method, edition, quantity, units, frequency range, source and receiver conditions, corrections and valid use.

Where two authorities require different methods, parallel tests or an approved equivalence analysis may be necessary.

333 MB-1261. U.S. Department of State, 12 FAM 510.
334 MB-1263. U.S. Department of State, 12 FAM 710.

A report that states only a number and an acronym is not sufficient evidence for cross-jurisdictional use.

Numerical equality does not establish technical or legal equivalence.

Metric collisions occur when identical abbreviations refer to different quantities or when different methods produce similarly named ratings. The crosswalk should store the complete standard, edition, symbol, equation, reference quantity, frequency range, averaging and result type. Displaying only a number and acronym invites an invalid comparison and can contaminate specifications, certificates and management dashboards.

Conversion should be performed only when the underlying band data and method relationship support it. A project may present parallel metrics without declaring them interchangeable. The acceptance record should identify which metric controls, which are supplementary, and whether uncertainty and guard bands were applied before or after any permitted transformation.

Table 32-9. Metric and method crosswalk

Quantity	Typical use	Required supporting data	Invalid shortcut
STC or Rw	Laboratory assembly rating	Full specimen and frequency data	Treating as installed room approval
ASTC, NIC or DnT,w family	Field relationship under method conditions	Positions, corrections, backgrounds and state	Direct conversion by equal number
STI	Speech intelligibility under defined transmission and noise	Source, modulation, background and processing	Treating as accreditation criterion
Closed-room privacy metric	Probabilistic privacy estimate under stated assumptions	Source distribution, isolation and background	Claiming zero intelligibility

Worked example 32.19. Metric-name collision

Engineering question. Two reports state ASTC 48 and DnT,w 48 dB. What numerical difference is displayed?

ΔN is only the displayed numerical difference.

Dimensional check for metric-name collision: like counts or like quantities cancel, leaving the stated dimensionless fraction, percentage or project screening index.

Engineering interpretation. The equal numbers remain results from different quantities and procedures.

Uncertainty and valid range. Method uncertainty and configuration are omitted.

What the calculation does not establish. Zero numerical difference does not establish equivalence.

32.20 Background noise, masking, and occupied states

Receiving background and deliberate masking can change speech recoverability without changing the boundary.[335]

Governmental frameworks differ in published masking doctrine and in whether acceptance criteria are public, protected or project specific.

The state matrix should include daytime and night HVAC, occupied and unoccupied spaces, masking normal and failed, power interruption, emergency modes and maintenance overrides.

Commissioning should map spectrum, level, uniformity, temporal stability, control settings, fault reporting and access to controllers.

335 MB-0230. ASTM International, ASTM E2638-24, ASTM E336-25a.

A room can appear private during noisy daytime operation and become vulnerable after hours or after a software update.

Masking is an active dependency. It does not repair an unrecorded construction defect or authorise discussion by itself.

Background sound and masking are state-dependent controls. The relevant spectrum can change with occupancy, weather, plant scheduling, fan speed, doors, maintenance and power mode. A daytime average may conceal a quiet night state, while a high broadband level may still provide poor masking in critical speech bands. The crosswalk should compare spectra and operating assurance, not merely A-weighted totals.

Masking systems require zoning, emitter coverage, level and spectral uniformity, controller security, fault monitoring, power resilience, tamper control and maintenance. If privacy depends upon masking, the approval condition should state the required state and response to failure. A system that is technically capable but routinely disabled, mis-zoned or inaudible in a critical area is not an effective control.

Worked example 32.20. Masking-state availability

Engineering question. A masking system is within its commissioned envelope for 710 of 720 operating hours.

A_m is masking availability.

Dimensional check for masking-state availability: like counts or like quantities cancel, leaving the stated dimensionless fraction, percentage or project screening index.

Engineering interpretation. Ten hours require incident review or operating restriction.[336]

Uncertainty and valid range. Logs may miss local emitter faults.

What the calculation does not establish. Availability does not repair envelope defects.

32.21 Doors, frames, seals, and sound locks

Openings frequently govern the complete envelope despite strong wall construction.[337]

Different governmental systems may prescribe protected hardware, inspection or vestibule arrangements that are not interchangeable with acoustic product ratings.

The common engineering review covers leaf mass and stiffness, frames, seals, thresholds, hardware preparations, alignment, pressure effects and operating force.

Evidence includes approved assemblies, installation records, gap measurements, functional tests, maintenance instructions and change triggers.

Wear, adjustment, propping, access-control additions and fire-door modifications can destroy the tested state.

A door rating does not establish room performance, security delay or governmental approval.

336 MB-1045. National Institute of Standards and Technology, FIPS 180-4, Secure Hash Standard.
337 MB-1267. U.S. Department of State, Bureau of Overseas Buildings Operations, Public mission and project-delivery information.

Door comparison must treat the complete assembly: leaf, frame, seals, threshold, hardware, glazing, power transfer, closer, latch, wall interface and installation tolerance. A laboratory-rated leaf installed in an unrelated frame is not the tested system. The crosswalk should also identify fire, egress, accessibility, forced-entry and operational requirements that constrain acoustic detailing.

Operational evidence should include closing force, latch engagement, seal compression, gap survey, hardware state, wear limits and maintenance response. Sound locks and vestibules need door-sequence assumptions and user behaviour controls. A room can pass with both doors closed yet fail in normal traffic if procedures, interlocks or staffing do not sustain that state.

Worked example 32.21. Door-gap area

Engineering question. A 0.95 m door has a 2 mm average bottom gap.

A_g is geometric gap area, w is width, and g is gap height.

Dimensional check for door-gap area: length products yield square metres and area-weighted ratios are dimensionless before any logarithmic conversion.

Engineering interpretation. A small area can dominate a high-isolation boundary.

Uncertainty and valid range. Gap height varies with alignment and pressure.

What the calculation does not establish. Area alone does not predict seal transmission.

32.22 Glazing, façades, and visual interfaces

Glazing combines acoustic, structural, optical, environmental and security functions.[338]

Diplomatic compounds, SCIFs, British secure areas and Canadian specialised rooms can impose different external-access, observation and technical-security assumptions.

Review should address pane make-up, cavity, frames, perimeter seals, vents, mullions, secondary glazing, façade flanking and laser or optical exposure.

The dossier should retain product reports, frame details, installation photographs, seal records, façade access assumptions and field measurements.

A strong glass make-up can be defeated by the frame, trickle vent, spandrel, roof edge or exterior maintenance access.

Acoustic performance does not establish optical, ballistic, blast or surveillance protection.

Glazing comparison should preserve pane composition, thickness, lamination, cavity, gas, frame, mullion, perimeter seal, vent, support and façade connection. Optical, thermal, structural, blast, ballistic and heritage requirements can alter the assembly and its acoustic behaviour. The highest-performing pane does not compensate for a weak frame or an open ventilation path.

Exterior access and surveillance assumptions may differ markedly among diplomatic, intelligence, British and Canadian contexts. The engineering dossier should therefore separate acoustic transmission, visual observation,

338 MB-0885. International Organization for Standardization, ISO 19650-5:2020.

vibration response, laser or optical exposure, cleaning access and façade maintenance. It should record which specialist authority owns each proposition and avoid treating one favourable test as evidence for the others.

Worked example 32.22. Glazing composite loss

Engineering question. Twelve square metres have 50 dB loss and one square metre of frame has 32 dB loss.

R_c is composite loss, S_i is area, and R_i is element loss.

Dimensional check for glazing composite loss: logarithmic quantities use compatible references, so subtraction remains in decibels and energetic combinations are applied only where stated.

Engineering interpretation. The small frame region substantially reduces the ideal composite.[339]

Uncertainty and valid range. Field leakage and flanking are omitted.

What the calculation does not establish. The result is not a façade approval.

32.23 HVAC, plenums, ducts, and plant states

Mechanical systems create connected air paths, regenerated noise, structure-borne paths and changing backgrounds.[340]

Jurisdictional requirements may allocate design, inspection and technical-security authority differently, especially in landlord-controlled buildings.

339 MB-1251. U.S. Department of Defense, UFGS public quality-control, photographic-documentation and closeout sections.
340 MB-1292. U.S. Department of State, Public diplomatic-security and facility-security programme descriptions.

The common analysis traces supply, return, transfer air, plenums, attenuators, dampers, access doors, supports, controls and balancing states.

Evidence includes schematics, equipment schedules, pressure and flow data, insertion-loss information, access control, commissioning states and maintenance procedures.

Night setback, filter change, damper position or fan replacement can alter both transmission and masking background.

A duct calculation or silencer rating does not establish installed privacy or authority acceptance.

HVAC crosswalks should map supply, return, transfer, relief, smoke-control and leakage paths as networks rather than isolated components. Relevant states include normal flow, setback, emergency purge, smoke mode, balancing, filter loading, damper position, fan failure and maintenance. Silencer insertion loss is meaningful only with airflow, regenerated noise, pressure drop, breakout and installation geometry considered together.

Plant rooms, plenums and service shafts alter both listener access and structure-borne transmission. The record should include duct routes, lining, joints, branches, terminal devices, supports, flexible connectors, access doors and balancing data. Where the public design team cannot receive a controlled vulnerability assessment, it should still receive authorised interface requirements and hold points sufficient to construct and verify the path.

Worked example 32.23. Duct attenuation balance

Engineering question. A silencer gives 22 dB, elbows 8 dB, terminal 4 dB, and regenerated noise costs 7 dB.

A_n is net screening attenuation.

Dimensional check for duct attenuation balance: logarithmic quantities use compatible references, so subtraction remains in decibels and energetic combinations are applied only where stated.

Engineering interpretation. The route appears to provide 27 dB under stated assumptions.

Uncertainty and valid range. Frequency and airflow dependence remain.

What the calculation does not establish. Arithmetic screening does not replace measurement.

32.24 Floors, ceilings, structure, and flanking

Structure and concealed cavities connect rooms beyond the visible partition.[341]

Different construction traditions and facility types change likely paths, but the need to trace junctions and connected elements is universal.

The model should include slabs, beams, columns, façades, raised floors, suspended ceilings, roof decks, wall heads, seismic joints and resilient supports.

Evidence should preserve structural drawings, connection details, vibration measurements, cavity inspections and intervention tests.

341 MB-1263. U.S. Department of State, 12 FAM 710.

A partition upgrade can fail because the dominant path is a continuous slab, ceiling grid, façade or underfloor system.

Structure-borne analysis is a physical mechanism, not a substitute for jurisdictional approval.

Structural flanking can bypass a high-performing partition through slabs, columns, beams, façades, roofs, raised floors, ceilings and support systems. Comparative analysis should distinguish airborne transmission, vibration transfer and reradiation. A national room label does not alter these physical mechanisms, but it can change which paths, adjoining zones, frequencies and evidence must be considered.

The path model should record junction geometry, material, continuity, resilient connections, loading, damping, supports and measurement locations. Interventions should be tested for collateral effects because stiffening, bridging or added mass can redistribute energy. A room-average result can conceal a local structural route to a quiet or intermittently occupied space.

Worked example 32.24. Parallel flanking paths

Engineering question. Path coefficients are 2e-5, 7e-6 and 3e-6.

$\tau\Sigma$ is total transmission coefficient.

Dimensional check for parallel flanking paths: logarithmic quantities use compatible references, so subtraction remains in decibels and energetic combinations are applied only where stated.

Engineering interpretation. The dominant path controls, but smaller paths reduce total isolation.[342]

Uncertainty and valid range. Path estimates may be correlated.

What the calculation does not establish. The model omits receiver normalisation and coherence.

32.25 Penetrations, utilities, and service interfaces

Every service crossing can create air leakage, mechanical coupling, firestop conflict and future change risk.[343]

National codes, governmental security requirements and landlord standards can assign different inspection and record duties.

The penetration register should identify service, location, sleeve, fill, seal system, support, fire rating, movement, access and responsible party.

First-of-type details, concealed-work photographs, material identity, inspection records and later-change controls are required.

Small undocumented additions accumulate until the weakest path is no longer represented by commissioning evidence.

A firestop listing, acoustic seal or security inspection cannot silently substitute for the others.

Penetrations should be governed through a register that links service identity, location, size, sleeve, annulus, sealing system, fire requirement, acoustic treatment, installer, inspection, photograph and later change. Bundled services and oversized openings deserve explicit analysis because

342 MB-1291. U.S. Department of State, Public definitions and descriptions of Acoustic Conference Room, Treated Conference Room and Modular Treated Conference Room.
343 MB-0230. ASTM International, ASTM E2638-24, ASTM E336-25a.

small geometric fractions can dominate a high-isolation boundary. Abandoned routes remain paths until positively closed and verified.

Utilities also convey vibration and pressure. Water piping, waste stacks, sprinkler mains, conduit, cable tray and rigid supports can bridge resilient construction or connect remote spaces. The crosswalk should separate firestop compliance, smoke control, structural movement, electromagnetic bonding and acoustic performance. Evidence for one function should not be copied into another column without a supported relationship.

Worked example 32.25. Penetration open fraction

Engineering question. Cable fill is 50 per cent and 8 per cent of the remaining annulus is open.

F_o is open fraction.

Dimensional check for penetration open fraction: like counts or like quantities cancel, leaving the stated dimensionless fraction, percentage or project screening index.

Engineering interpretation. Four per cent open area is material for a sensitive boundary.

Uncertainty and valid range. Visual estimates are uncertain.

What the calculation does not establish. The fraction does not predict fire or acoustic rating.

32.26 Conferencing, telephony, audiovisual systems, and sensors

Electronic systems can inject, capture, transmit, store or amplify audio while also changing penetrations and structural paths.[344]

Governmental programmes differ in approved products, network authority, secure voice arrangements and technical-security review.

The system inventory should include microphones, loudspeakers, cameras, codecs, displays, USB and network interfaces, wireless radios, sensors, remote support and software states.

Evidence includes approved architecture, device identity, firmware, configuration exports, network authorisation, cable routes, muting tests and maintenance controls.

A visually muted endpoint can retain an active microphone or remote diagnostic path, while a replacement display can add fans, radios or different mounts.

Acoustic construction does not authorise electronic processing or secure voice.

Audiovisual and conferencing systems create source, receiver, storage, network and structural interfaces. The inventory should include every microphone, loudspeaker, codec, camera, display, USB or network peripheral, wireless radio, diagnostic service, sensor, control processor and support account. Muted, sleeping and maintenance states should be verified rather than inferred from an icon or front-panel light.

344 MB-0982. JCGM 100:2008, JCGM 106:2012.

The comparative overlay should identify product approval, secure voice, network authorisation, firmware baseline, configuration export, remote support, cable routing and penetration controls. An endpoint can satisfy acoustic installation requirements while remaining unauthorised for the information processed. Conversely, an approved electronic product can still create an acoustic, vibration or support-bracket weakness in the room boundary.

Worked example 32.26. Electronic-state coverage

Engineering question. A conferencing system has 18 states and 14 have approved tests.

C_e is approved tested-state coverage.

Dimensional check for electronic-state coverage: like counts or like quantities cancel, leaving the stated dimensionless fraction, percentage or project screening index.

Engineering interpretation. Four maintenance or failure states remain outside evidence.[345]

Uncertainty and valid range. Vendor state enumeration may be incomplete.

What the calculation does not establish. Coverage does not authorise classified processing.

345 MB-1261. U.S. Department of State, 12 FAM 510.

32.27 Cyber authorisation and facility-related control systems

Cybersecurity and physical acoustic security intersect at controllers, networks, logs, remote access and configuration state.[346]

United States RMF, British cyber assurance and Canadian control catalogues use different institutional processes and evidence structures.

Facility systems should be inventoried by function, network, trust boundary, credential, update path, remote access, logging and fail-safe state.

The crosswalk should link cyber authorisation records to the physical configuration without treating either as complete evidence for the other.

A cyber-authorised controller can still create an acoustic failure state, and an acoustically compliant device can remain unauthorised on the network.

Authorisation boundaries must remain explicit and separately owned.

Cyber authorisation should be linked to the physical configuration through device identifiers, network segments, trust boundaries, credentials, software versions, logs and remote-access paths. Facility-related control systems can change masking, ventilation, doors, alarms and power states. The crosswalk should show these dependencies without treating cyber approval as proof of acoustic performance or vice versa.

Configuration evidence should be reproducible. Signed exports, checksums, certificate inventories, software bills of materials, approved ports and golden-state comparisons allow later investigators to determine whether a physical performance change coincided with a digital change. Emergency override and fail-safe logic need their own acoustic and security states

346 MB-1267. U.S. Department of State, Bureau of Overseas Buildings Operations, Public mission and project-delivery information.

because a safe life-safety response can temporarily alter protective conditions.

Worked example 32.27. Cyber-physical control overlap

Engineering question. Thirty physical controls and 24 cyber controls are listed; 9 require joint ownership.

F_j is the Jaccard overlap.

Dimensional check for cyber-physical control overlap: like counts or like quantities cancel, leaving the stated dimensionless fraction, percentage or project screening index.

Engineering interpretation. One fifth of the combined control set needs explicit joint governance.

Uncertainty and valid range. Control definitions may differ in granularity.

What the calculation does not establish. Overlap does not merge authorisation boundaries.

32.28 TSCM and technical-security authority

Technical surveillance countermeasures examine threats beyond ordinary acoustic leakage.[347]

The Department of State, United States Intelligence Community, UK NACE and Canadian authorities organise technical-security support differently and may protect methods and findings.

347 MB-1251. U.S. Department of Defense, UFGS public quality-control, photographic-documentation and closeout sections.

The project should define when specialist review is required, what construction information can be shared, how findings are controlled and how remediation enters the configuration baseline.

Evidence is normally a controlled authority record, not a public checklist of vulnerabilities or search methods.

Treating an acoustic test as TSCM or publishing sensitive findings can create both false assurance and exploitable disclosure.

This chapter describes institutional boundaries. It does not provide adversarial search procedures or restricted criteria.

TSCM is a specialist security function with protected methods, findings and reporting channels. The comparative chapter should identify the competent authority, referral trigger, construction-information interface, scheduling dependency and controlled disposition without publishing search patterns or vulnerabilities. Ordinary sound-isolation measurement can support a broader assessment, but it is not a substitute for TSCM.

Findings should enter the configuration baseline through a minimised action record. The construction team may need a location, authorised repair and inspection hold point while the underlying detection method and threat assessment remain restricted. Closure should be confirmed by the responsible technical-security authority, not inferred from the contractor's completion notice or a favourable acoustic retest alone.

Worked example 32.28. TSCM finding closure

Engineering question. A controlled review records 17 findings and 15 are closed.

C_f is finding closure.

Dimensional check for tscm finding closure: like counts or like quantities cancel, leaving the stated dimensionless fraction, percentage or project screening index.

Engineering interpretation. Two findings remain subject to authority disposition.[348]

Uncertainty and valid range. Closure quality cannot be assessed from counts alone.

What the calculation does not establish. The ratio reveals no protected finding details.

32.29 TEMPEST, EMSEC, and compromising emanations

Electromagnetic-security controls address unintentional intelligence-bearing emanations and associated facility conditions.[349]

Department of State TCR terminology, United States IC criteria, NCSC TEMPEST services and Canadian ITSG-11A or CITP structures are not interchangeable.

The engineering interface includes equipment identity, shielding, grounding, cable routes, penetrations, separation, power, maintenance and authorised technical evaluation.

Records should distinguish equipment certification, facility evaluation, policy compliance, installation evidence and authority decision.

348 MB-1292. U.S. Department of State, Public diplomatic-security and facility-security programme descriptions.
349 MB-1257. U.S. Department of State, 12 FAM 010.

A certified product can fail through installation, while an RF-shielded room can remain acoustically weak or cyber-unapproved.

Protected thresholds and test methods are not reconstructed from public descriptions.

TEMPEST and EMSEC address compromising emanations and related installation conditions, not merely audible sound. Public sources can establish programme roles, terminology and the existence of controlled criteria, but they do not authorise reconstruction of thresholds, zoning or test procedures. The crosswalk should therefore keep acoustic, electromagnetic, radio-frequency, optical and cyber evidence in separate but linked records.

Installation coordination remains essential because shielding, bonding, cable entry, power filtering, penetrations, equipment placement and maintenance can affect several disciplines. A change proposed for acoustic reasons should be reviewed for EMSEC consequences where applicable. The public dossier should record the review and authorised disposition without exposing controlled measurements or facility-specific weaknesses.

Table 32-10. Technical-security domain boundaries

Domain	Primary question	Evidence	Cannot establish alone
Acoustic security	Can speech energy be recovered through acoustic paths?	Band data, state matrix and listener assumptions	TSCM, EMSEC or cyber approval
TSCM	Are technical surveillance threats present or insufficiently controlled?	Controlled specialist assessment	Ordinary room rating

Domain	Primary question	Evidence	Cannot establish alone
TEMPEST or EMSEC	Are compromising emanations adequately controlled?	Authorised product and facility evidence	Acoustic privacy
Cyber authorisation	Are systems authorised within cyber boundaries?	RMF or national cyber evidence	Physical envelope performance

Worked example 32.29. EMSEC installation evidence

Engineering question. Twenty-six required installation evidence items exist and 23 are accepted.

C_i is installation-evidence closure.

Dimensional check for emsec installation evidence: like counts or like quantities cancel, leaving the stated dimensionless fraction, percentage or project screening index.

Engineering interpretation. Three items can block facility evaluation.

Uncertainty and valid range. Acceptance status can change after technical review.

What the calculation does not establish. The ratio does not disclose protected criteria.

32.30 Construction-security governance

Secure construction protects both the resulting facility and the information, materials and processes used to create it.[350]

350 MB-1261. U.S. Department of State, 12 FAM 510.

The Department of State construction-security programme, IC and DoD controls, British construction-security services and Canadian CSP processes assign different roles and access conditions.

A construction-security plan should cover design information, personnel, deliveries, storage, surveillance, tools, waste, concealed work, nonconformance and incident response.

The record should link every protected detail to authorised access, observation, evidence and final disposition.

Uncontrolled substitution, undocumented access or missed concealment can invalidate later confidence even when the finished room looks correct.

Construction security is programme specific and cannot be inferred from ordinary site safety or quality control.

Construction-security governance begins before mobilisation. It should define protected information, screened personnel, site zones, material routes, storage, surveillance, escorts, photography, tools, temporary services, incident reporting, records and stop-work authority. The crosswalk should distinguish general construction quality from the additional assurance required when concealed work or adversarial access is material.

Evidence should be timed to the work. A photograph after closure cannot prove the identity, continuity or cleanliness of a hidden layer unless the relevant stage was witnessed and recorded. The surveillance plan should identify mandatory hold points, authorised alternatives when a point is missed, and the authority that decides whether opening, testing, mitigation or rejection is required.

Figure 32-4. Construction-security evidence chain. Author's original diagram.

Worked example 32.30. Construction hold-point coverage

Engineering question. Forty-eight hold points were planned and 45 were observed.

C_h is hold-point coverage.

Dimensional check for construction hold-point coverage: like counts or like quantities cancel, leaving the stated dimensionless fraction, percentage or project screening index.

Engineering interpretation. Three missed observations require authorised recovery or nonconformance.[351]

Uncertainty and valid range. An observation can be incomplete even if counted.

What the calculation does not establish. Coverage is not proof of final performance.

32.31 Procurement, material identity, and supply-chain assurance

Procurement determines whether the installed system matches approved evidence and whether sensitive information is exposed unnecessarily.[352]

National procurement rules, approved-product schemes and industrial-security arrangements differ in scope and legal effect.

Specifications should define functional requirements, protected details, acceptable evidence, submittals, substitutions, custody, tamper indication and change notification.

351 MB-1291. U.S. Department of State, Public definitions and descriptions of Acoustic Conference Room, Treated Conference Room and Modular Treated Conference Room.
352 MB-1292. U.S. Department of State, Public diplomatic-security and facility-security programme descriptions.

Material and equipment records need manufacturer, model, revision, lot or serial identity, certificate, shipment history, installation location and disposition.

A commercially similar substitute can change mass, stiffness, firmware, radio functions, fire performance or supply-chain risk.

Approval in one programme does not create automatic acceptance in another.

Supply-chain assurance should preserve the identity and custody of critical materials, equipment, software and services. Records may include manufacturer, model, serial or batch, authorised distributor, shipping route, seals, storage, receipt inspection, firmware, certificates and substitution approval. The level of detail should be proportionate to consequence and should avoid disclosing a complete bill of protective vulnerabilities to unnecessary recipients.

A technically equivalent substitution is not self-authorising. It can change acoustic performance, fire listing, electromagnetic behaviour, network trust, maintenance capability or evidence provenance. The change package should identify affected requirements, tests, authorities and records before installation. Emergency procurement should use a documented temporary disposition with expiry, compensating measures and a route to permanent closure.

Table 32-11. Procurement and supply-chain evidence

Item	Identity record	Security control	Change response
Construction material	Manufacturer, type, lot and location	Custody and substitution approval	Reinspect and update as-built record

Item	Identity record	Security control	Change response
Door or glazing system	Model, hardware and tested configuration	Approved supplier and installation evidence	Technical and authority review
Electronic device	Model, serial, firmware and radios	Supply-chain and cyber review	State testing and authorisation update
Seal or firestop	Product, batch, joint and installer	Listed system and controlled installation	Repair, inspect and retest as required

Worked example 32.31. Supply-chain identity coverage

Engineering question. One hundred twenty installed items require traceability and 113 have complete identity records.

C_s is traceability coverage.

Dimensional check for supply-chain identity coverage: like counts or like quantities cancel, leaving the stated dimensionless fraction, percentage or project screening index.

Engineering interpretation. Seven items require reconciliation.

Uncertainty and valid range. Serial or lot records can contain transcription errors.

What the calculation does not establish. Traceability does not prove product authenticity by itself.

32.32 Information management, digital models, and controlled annexes

Digital models and collaborative platforms can expose layouts, penetrations, security systems and authority assumptions.[353]

353 MB-0535. Office of the Law Revision Counsel, U.S. House of Representatives, 22 U.S.C. section 4802, Responsibility of Secretary of State.

Information-classification and release processes differ, but all require deliberate minimisation and accountable sharing.

The common model should use neutral identifiers and limited geometry, with controlled annexes or federated views for restricted details.

Access logs, version history, export controls, naming, metadata, retention, checksums and incident response should be part of the project information plan.

A harmless-looking model export can reveal compound vulnerabilities or retain deleted layers and metadata.

Technical convenience does not override originator control or national release authority.

Security-minded information management should classify information by consequence of compromise, not merely by file type. Drawings, models, schedules, photographs, test data, access logs and maintenance records can reveal protective architecture when combined. The common data environment should enforce identity, least privilege, versioning, approval state, download control, audit logging, retention and secure disposal.

Controlled annexes allow multidisciplinary coordination without universal access to sensitive detail. The open model can contain an interface object and action identifier while the protected annex contains the criterion or vulnerability. Links must survive version changes, and automated exports should be checked for hidden layers, properties, comments and embedded objects. A clean visual PDF is not proof that underlying data have been removed.

Table 32-12. Information-model and annex architecture

Layer	Audience	Content	Control
Neutral core	Broad authorised project team	Functional requirements and stable identifiers	Security-minded information management
Jurisdiction overlay	Country or authority team	Official terms, forms and public criteria	Role-based access
Controlled technical annex	Specialist authorised group	Protected criteria and sensitive details	Controlled repository and audit
Decision register	Named authorities and custodians	Conditions, deviations and approvals	Versioning and retention

Worked example 32.32. Controlled-model access reduction

Engineering question. A model has 80 users, but a restricted view needs only 12.

R_a is access reduction.

Dimensional check for controlled-model access reduction: like counts or like quantities cancel, leaving the stated dimensionless fraction, percentage or project screening index.

Engineering interpretation. A federated controlled view can exclude 85 per cent of users.[354]

Uncertainty and valid range. Role changes can alter need.

What the calculation does not establish. Reduction does not determine lawful recipients.

32.33 Inspection, surveillance, and hold points

Inspection converts approved intent into evidence about actual construction.[355]

354 MB-0536. U.S. Department of State, 1 FAM 260, Bureau of Diplomatic Security.
355 MB-0537. U.S. Department of State, 12 FAM 310.

Jurisdictions differ in who may inspect protected work, what records can be created and how missed observations are recovered.

The inspection plan should identify first-of-type work, concealed stages, sampling, instruments, photographs, witnesses, stop-work authority and acceptance criteria.

Each hold point requires a stable requirement identifier, observed condition, date, location, responsible people and disposition.

If work is concealed without authorised observation, later testing may not identify the exact defect or establish the required chain of confidence.

A missed hold point is missing evidence, not automatic acceptance.

Inspection planning should be risk-based but reproducible. Each hold point should identify the feature, stage, competent inspector, evidence, tolerance, sampling rule, failure response and authority for release. Repetitive work may justify sampling only after a first-of-type installation demonstrates process capability and the consequence of an undetected defect has been considered.

Surveillance records should separate observation from acceptance. An inspector can record what was visible without approving the design, and a security witness can verify custody without certifying acoustic performance. Missed inspections require a documented recovery method such as opening, non-destructive examination, testing, enhanced sampling or authority-approved mitigation. Silence in the diary is not evidence of compliance.

Worked example 32.33. Inspection sampling fraction

Engineering question. A repetitive installation has 240 units and 60 are inspected.

f_s is sample fraction.

Dimensional check for inspection sampling fraction: like counts or like quantities cancel, leaving the stated dimensionless fraction, percentage or project screening index.

Engineering interpretation. The plan inspects one quarter of the population.

Uncertainty and valid range. Defect clustering can invalidate random-sample assumptions.

What the calculation does not establish. Sampling cannot replace mandatory first-of-type or hold points.

32.34 Mock-ups and first-of-type installations

Mock-ups reduce uncertainty before repetitive work is concealed or multiplied.[356]

Authorities may treat mock-ups as design evidence, construction qualification, training or a formal acceptance stage, and those meanings should not be conflated.

The first-of-type should reproduce interfaces, workmanship, tolerances, services, access and inspection conditions rather than a simplified display sample.

356 MB-0538. U.S. Department of State, 12 FAM 310.

Records should capture drawings, materials, sequence, photographs, measurements, defects, corrections and approved replication rules.

A visually attractive mock-up can omit the very junction, penetration or operational state that controls security performance.

Mock-up approval is limited to the represented configuration and purpose.

Mock-ups should test interfaces and processes, not merely display a finished appearance. A useful specimen includes representative framing, joints, seals, penetrations, hardware, services, finishes and installation sequence. It should expose the features that will become concealed and permit dimensional, acoustic, fire, structural and security observations before repeated production begins.

First-of-type approval should define what may be replicated and what remains subject to inspection. A passing mock-up does not authorise unrecorded material changes, altered substrate, different crew, compressed curing time or inaccessible geometry. Lessons should be converted into revised drawings, method statements, checklists and training, then verified in early production rather than left as meeting minutes.

Worked example 32.34. Mock-up defect reduction

Engineering question. The first mock-up has 14 defects and the corrected second mock-up has 4.

R_d is defect reduction.

Dimensional check for mock-up defect reduction: like counts or like quantities cancel, leaving the stated dimensionless fraction, percentage or project screening index.

Engineering interpretation. The process improved substantially before production.[357]

Uncertainty and valid range. Defect severity is not represented.

What the calculation does not establish. A lower count does not prove production compliance.

32.35 Measurement methods and instrumentation

Measurements must be tied to the proposition and method that justify them.[358]

ASTM, ISO, IEC and controlled governmental methods can differ in instrumentation, positions, corrections and reporting.

The plan should identify microphones, analysers, sources, calibrators, vibration sensors, intensity probes, software, settings and environmental limits.

Instrument identity, calibration certificates, pre- and post-checks, raw data, processing scripts and operator competence must be retained.

A sophisticated instrument cannot cure an undefined measurand, unsuitable dynamic range or unrepresentative state.

Instrument compliance is necessary but not sufficient for facility approval.

Measurement planning should start with the decision and work backwards to the measurand, range, bandwidth, positions, states, instrumentation and uncertainty. The same microphone and analyser can support different methods, but the resulting quantities are not interchangeable. The test plan

357 MB-0539. U.S. Department of State, Bureau of Overseas Buildings Operations, OBO public project portfolio, Overseas Buildings Operations Project Portfolio.
358 MB-0540. U.S. Department of State, 12 FAM 010.

should identify the controlling standard, permitted deviations, source stability, background limits, calibration and raw-data format.

Instrumentation records should preserve model, serial number, firmware, calibration certificate, field checks, range, overload status, environmental conditions and synchronisation where relevant. Spatial sampling must represent the physical question, including local leakage and remote flanking positions. Automated software should retain settings and intermediate data so that a reviewer can reproduce the reported result rather than trust a single exported rating.

Worked example 32.35. Instrument calibration drift

Engineering question. A calibrator check changes from 94.0 dB to 93.6 dB.

D_c is calibration drift.

Dimensional check for instrument calibration drift: logarithmic quantities use compatible references, so subtraction remains in decibels and energetic combinations are applied only where stated.

Engineering interpretation. The drift must be compared with method tolerance and uncertainty.

Uncertainty and valid range. Checks themselves have uncertainty.

What the calculation does not establish. The drift alone does not show which measurements are invalid.

32.36 Calibration, uncertainty, and decision rules

A result without uncertainty and a predeclared decision rule cannot support a defensible cross-jurisdictional comparison.[359]

359 MB-0541. U.S. Department of State, 12 FAM 010.

Authorities can adopt different conformity-risk tolerances even when they accept the same measurement data.

The uncertainty budget should include calibration, repeatability, spatial sampling, background, source stability, environmental state, processing and model discrepancy where appropriate.

The report should state coverage factor, expanded uncertainty, guard band, rule, false-accept and false-reject implications, and unresolved limitations.

Post hoc adjustment of the rule to obtain a desired outcome destroys evidentiary credibility.

A public uncertainty method does not disclose or replace a controlled acceptance threshold.

Uncertainty should be attached to the measured or calculated quantity and propagated through the actual decision model. Components may include calibration, repeatability, spatial variation, source stability, background correction, decay estimation, geometry, environmental effects and data reduction. Correlated terms should not be combined as though independent merely because a spreadsheet offers a root-sum-square function.

Decision rules should state how uncertainty affects acceptance, including any guard band and the relative consequences of false acceptance and false rejection. Different authorities or contracts can choose different rules for the same measured value. The report should therefore present the result, uncertainty, rule and decision separately. It should not conceal a marginal result behind rounding or the bare word pass.

Table 32-13. Uncertainty and decision-rule record

Field	Required statement	Crosswalk purpose
Measurand	Exact quantity and method	Prevents metric collision
Uncertainty model	Components, combination and coverage	Shows evidentiary strength
Acceptance limit	Authority-owned criterion	Prevents invented threshold
Decision rule	Guard band and conformity risk	Makes pass or fail reproducible
Limitations	Untested states and inaccessible paths	Bounds inference

Worked example 32.36. Combined standard uncertainty

Engineering question. Independent components are 0.8, 1.1 and 0.6 dB.

u_c is combined standard uncertainty.

Dimensional check for combined standard uncertainty: logarithmic quantities use compatible references, so subtraction remains in decibels and energetic combinations are applied only where stated.

Engineering interpretation. A coverage factor may be applied for expanded uncertainty.[360]

Uncertainty and valid range. Independence may not hold.

What the calculation does not establish. Uncertainty does not alter the authority limit.

32.37 Evidence classes and chain of inference

Different evidence classes answer different questions and must not be silently substituted.[361]

360 MB-0542. U.S. Department of State, 1 FAM 260, Bureau of Diplomatic Security.
361 MB-0543. ASTM International, ASTM E336-25a.

A design calculation, laboratory report, submittal, inspection, field test, authority memorandum and operating record occupy distinct places in the chain.

The dossier should label as-required, as-designed, as-submitted, as-procured, as-installed, as-tested, as-approved and as-operated states.

Stable identifiers and cross-references should allow a reviewer to trace every conclusion back to observations, assumptions and authority.

A favourable later test can obscure unexplained construction deviations, while a complete inspection cannot prove performance under every state.

The strongest conclusion is bounded by the weakest necessary evidence link.

Evidence should be classified by what it can prove. Design calculations support prediction; product reports support a defined specimen; photographs support visible condition at a moment; calibration records support instrument status; field tests support an installed state; and an authority letter supports the decision within its stated scope. No single record should be credited with a stronger proposition than it actually establishes.

The chain of inference should remain inspectable from observation to conclusion. Each step should identify assumptions, alternative explanations, uncertainty and contrary evidence. Where a controlled authority makes the final decision, the public dossier can record that decision and its conditions without exposing the protected analysis. A gap in the public explanation should be labelled, not filled with speculation.

Figure 32-5. Evidence ladder and maximum defensible inference. Author's original diagram.

Worked example 32.37. Evidence-chain completeness

Engineering question. Eight necessary evidence classes are defined and seven are present.

C_e is evidence completeness.

Dimensional check for evidence-chain completeness: like counts or like quantities cancel, leaving the stated dimensionless fraction, percentage or project screening index.

Engineering interpretation. The missing class can bound the strongest conclusion.

Uncertainty and valid range. Classes do not have equal importance.

What the calculation does not establish. A percentage cannot excuse a mandatory missing record.

32.38 Nonconformance, deviation, waiver, and compensating measures

A departure from a requirement must be classified and disposed of under the correct authority.[362]

The terms waiver, exception, deviation, concession, mitigation and compensating measure can have different formal effects across programmes.

The register should state requirement, observed condition, cause, consequence, alternatives, temporary controls, approving authority, expiry and closure evidence.

362 MB-0544. U.S. Department of State, 12 FAM 310.

Engineering analysis should quantify affected paths and uncertainty, while the authority decides whether residual risk is acceptable.

Informal field acceptance or a consultant email can become mistaken for a permanent governmental waiver.

Terminology must follow the governing programme. A neutral project label should not erase legal effect.

Nonconformance, deviation, waiver and compensating measure should remain distinct. A nonconformance records departure from a requirement; a deviation may authorise a prospective departure; a waiver may accept an existing one; and a compensating measure reduces risk without erasing the departure. Terminology and authority vary, so the register should preserve the originating process and decision.

Every disposition should identify the affected requirement, cause, extent, immediate control, technical analysis, alternatives, residual risk, evidence, approver, conditions, expiry and recurrence prevention. Closing the construction item without closing the authority condition creates a false completion state. Repeated minor deviations should trigger systemic review even where each was individually accepted.

Worked example 32.38. Deviation residual score

Engineering question. A deviation has likelihood 2, consequence 5 and detectability penalty 3.

R_d is a project screening score.

Dimensional check for deviation residual score: like counts or like quantities cancel, leaving the stated dimensionless fraction, percentage or project screening index.

Engineering interpretation. The deviation requires comparison with alternatives and authority review.[363]

Uncertainty and valid range. Ordinal factors are judgemental.

What the calculation does not establish. The score is not an approval threshold.

32.39 Acceptance, certification, accreditation, and use decisions

The final decision architecture should show what each approval actually permits.[364]

Contractual acceptance may concern workmanship, certification may concern a programme step, accreditation may concern a facility, and authority to operate may concern a defined use.

The decision matrix should identify decision maker, inputs, configuration, conditions, validity, reciprocity, review date and revocation or change triggers.

Handover should include unresolved items, temporary conditions and a statement of what remains outside the decision.

Projects often overstate completion by collapsing several approvals into one word such as accepted.

363 MB-0545. U.S. Department of State, 15 FAM 1010, Overview, Scope, Authority, and General Policy for Capital Projects.
364 MB-0546. U.S. Department of State, 15 FAM 650, Facility Management Support for Major Projects.

Only the named authority can issue the decision within its jurisdiction.

Acceptance should be decomposed into evidence closure, technical conclusion and authority decision. A complete test report may support acceptance without itself accepting the facility. Certification can address construction or programme requirements, accreditation can recognise a facility for a defined use, and authority to operate can impose conditions that extend beyond the physical room. The crosswalk should retain each verb in its governing context.

The final dossier should list open conditions, excluded spaces, untested states, expiry dates, operating restrictions, monitoring and reapproval triggers. Management summaries should not truncate these limitations. A facility described as approved without scope and conditions invites use for information, systems or partners that the underlying decision never considered.

Table 32-14. Approval and authority matrix

State	Evidence complete?	Authority decision?	Use status
Designed	No	No	Not authorised
Constructed	Partly	No	Not authorised
Tested	Technical evidence exists	Not necessarily	Not authorised unless authority decides
Accredited or approved	Required authority decision exists	Yes within conditions	Permitted within written scope
Changed	Prior evidence may be stale	Review required	Restrict until disposition

Worked example 32.39. Approval-condition closure

Engineering question. An accreditation has 12 conditions and 10 are closed.

C_c is condition closure.

Dimensional check for approval-condition closure: like counts or like quantities cancel, leaving the stated dimensionless fraction, percentage or project screening index.

Engineering interpretation. Two conditions continue to limit use.

Uncertainty and valid range. A condition may be more consequential than several others.

What the calculation does not establish. The ratio cannot broaden the written decision.

32.40 Reciprocity and cross-recognition

Reciprocity reduces duplicated review only where the governing authority recognises the prior decision and the configuration remains applicable.[365]

IC reciprocity, departmental acceptance, allied use and industrial-security recognition can each have different prerequisites and exclusions.

A reciprocity request should map authority, facility identity, mission, information, users, configuration, prior evidence, changes and proposed conditions.

The record must preserve the written recognition decision and any additional local controls.

Assuming reciprocity from similar construction or allied status can leave a facility used without authority.

Reciprocity is an authority decision, not an engineering conversion.

365 MB-0547. U.S. Department of State, 15 FAM 650, Facility Management Support for Major Projects.

Reciprocity is a decision process, not automatic transport of an approval. The receiving authority should compare mission, information, construction, configuration, inspection, test evidence, unresolved findings, changes and continuing assurance. It may accept prior work, request supplementary evidence, impose conditions or require a new assessment.

A reciprocity package should minimise duplicate testing while preserving sovereign or departmental authority. Reusable raw data and traceable evidence are more valuable than a conclusory certificate because the receiving authority can apply its own rule. Changes since the originating decision should be listed explicitly; an old approval attached to a materially changed room is not reciprocal evidence.

Worked example 32.40. Reciprocity change delta

Engineering question. A prior facility had 40 relevant baseline attributes; 6 have changed.

F_Δ is changed-attribute fraction.

Dimensional check for reciprocity change delta: like counts or like quantities cancel, leaving the stated dimensionless fraction, percentage or project screening index.

Engineering interpretation. The six changes must be assessed before reciprocity is requested.[366]

Uncertainty and valid range. Attribute weighting is not represented.

What the calculation does not establish. A small fraction can still contain a decisive change.

366 MB-0548. U.S. Government Accountability Office, GAO-25-107582, Embassy Construction: State Has Made Progress but Could Improve Project Performance Information.

32.41 Change control and material change

Secure-room assurance is configuration dependent and must survive physical, electronic and operational change.[367]

Jurisdictions vary in terminology and review route, but all can invalidate prior evidence when the protected state changes materially.

The change register should cover construction, seals, penetrations, HVAC, masking, endpoints, firmware, access, tenancy, mission, source states and adjoining spaces.

Impact screening should identify affected authorities, inspections, tests, documents, restrictions and decision records before work begins.

Minor maintenance can become a material security change when it opens a path or changes a controller state.

Historical approval is evidence of a past configuration, not automatic proof of the current one.

Change control should screen physical, electronic, operational and organisational changes. New penetrations, furniture, displays, microphones, door hardware, plant schedules, network configuration, masking levels, tenancy, adjoining access and information use can all alter the accepted proposition. The screening threshold should be defined by consequence and path impact, not merely by project cost.

A material change should trigger a tailored impact assessment that identifies affected requirements, authorities, tests, records and interim controls. Emergency work should be logged before or immediately after

367 MB-0549. U.S. Department of State, 15 FAM 110, General Authorities and Responsibilities for Overseas Real Property Management.

execution, with photographs and temporary conditions. Recommissioning should be proportionate to the changed paths, but the justification for limiting its scope must be recorded and approved.

Figure 32-6. Lifecycle and material-change review loop. Author's original diagram.

Worked example 32.41. Material-change screening

Engineering question. A change scores 3 for path effect, 2 for information exposure, 4 for authority impact and 2 for reversibility.

I_c is a screening index.

Dimensional check for material-change screening: like counts or like quantities cancel, leaving the stated dimensionless fraction, percentage or project screening index.

Engineering interpretation. The high authority component indicates early consultation.

Uncertainty and valid range. Scales are project conventions.

What the calculation does not establish. The index does not decide whether reaccreditation is required.

32.42 Maintenance, drift, and recommissioning

Maintenance preserves the authorised state only when its effects are understood, recorded and verified.[368]

Governmental programmes differ in required intervals and reporting, while manufacturers and landlords can introduce additional constraints.

The maintenance plan should include doors, seals, masking, HVAC, sensors, communications, shielding interfaces, penetrations and evidence systems.

368 MB-0550. U.S. Government Accountability Office, GAO-23-105887, State Department: Additional Steps Are Needed to Improve Overseas Facility Resilience.

Trend records should identify tolerances, alarm levels, responsible technicians, spare identities, tests and authority notifications.

Gradual drift can escape notice because each individual adjustment appears small.

Preventive maintenance does not replace event-driven recommissioning after consequential change.

Maintenance preserves a configured system rather than a collection of independent components. Schedules should include doors, seals, masking, HVAC, silencers, penetrations, supports, sensors, power, software, calibration and access controls. Trend limits and failure responses should be tied to the acceptance basis so that gradual drift is identified before it becomes an unexplained security loss.

Maintenance evidence should identify technician, eligibility, work performed, parts, configuration before and after, tests, anomalies and required authority notification. A like-for-like replacement can still differ in batch, firmware, mounting or tolerances. Recommissioning intervals should therefore combine periodic review with event-driven triggers and observed performance, rather than rely solely upon the calendar.

Worked example 32.42. Maintenance completion

Engineering question. Thirty-six planned tasks are due and 34 are closed.

C_m is maintenance completion.

Dimensional check for maintenance completion: like counts or like quantities cancel, leaving the stated dimensionless fraction, percentage or project screening index.

Engineering interpretation. Two overdue tasks require risk review.[369]

Uncertainty and valid range. Completion records can overstate work quality.

What the calculation does not establish. The percentage does not prove the authorised state.

32.43 Incident response and forensic preservation

A suspected compromise or unexplained performance change requires controlled technical and evidentiary response.[370]

Reporting routes, investigative authority and protected handling vary across departments and countries.

The response plan should preserve access logs, recordings where lawful, device state, configuration exports, raw measurements, photographs, witness accounts and change history.

Initial actions should prevent further loss while avoiding destructive alteration of the scene or unsupported causal claims.

Well-intentioned repairs can erase the condition needed to determine whether the cause was construction, equipment, operation or deliberate interference.

This chapter defines evidence discipline, not classified investigative procedure.

Incident response should preserve the scene and the configuration while protecting people and information. Initial triage should establish who has

369 MB-0551. Office of the Law Revision Counsel, U.S. House of Representatives, 22 U.S.C. section 4852, Diplomatic Construction Program.
370 MB-0552. U.S. Department of State, 12 FAM 360.

authority, what can be isolated safely, which logs and volatile data require capture, and whether ordinary repair would destroy evidence. Photographs, measurements, access records, device state, configuration exports and witness accounts should be time-synchronised where practicable.

Causal attribution should distinguish construction defect, degradation, operational error, unauthorised change, equipment failure and deliberate interference. The investigation should test competing hypotheses and record negative findings. Sensitive technical-security results can remain controlled while the remediation register receives an authorised action. Closure requires both restoration of performance and disposition of the incident by the responsible authority.

Worked example 32.43. Incident evidence recovery

Engineering question. Twenty-four evidence sources are identified and 20 are preserved.

C_i is evidence preservation coverage.

Dimensional check for incident evidence recovery: like counts or like quantities cancel, leaving the stated dimensionless fraction, percentage or project screening index.

Engineering interpretation. Four lost sources constrain causal inference.

Uncertainty and valid range. Some sources may be duplicative or low quality.

What the calculation does not establish. Coverage does not reveal protected evidence content.

32.44 Landlord, host-building, contractor, and third-party interfaces

Secure rooms frequently depend upon people and systems outside the immediate organisational boundary.[371]

Lease law, base-building control, contractor security and governmental authority differ across jurisdictions and locations.

Interface schedules should govern roof, façade, risers, plant rooms, utilities, cleaning, pest control, emergency access, software support and notification of nearby work.

Contracts and operating agreements should define access, escorting, evidence, change notice, incident reporting and restoration.

A third party can alter a critical path without entering the protected room.

The security authority must decide whether contractual and technical controls adequately bound third-party access.

Third-party interfaces should be treated as controlled dependencies. Landlords, building managers, utilities, cleaners, pest contractors, fire-system maintainers, software vendors and emergency responders can access routes or states that affect the protected room without entering it. Contracts should define notice, access, escorting, records, incident reporting, restoration and restrictions on remote support.

The interface register should identify the physical and organisational boundary for each dependency. Roof, façade, riser, plant room, ceiling void, shared network and base-building control system responsibilities should have named owners and escalation routes. Where a third party cannot

371 MB-0553. U.S. Department of State, 12 FAM 350.

accept the required control, the project must consider technical separation, monitoring, operating restrictions or relocation rather than assume goodwill is sufficient.

Worked example 32.44. Third-party obligation closure

Engineering question. A landlord schedule contains 32 obligations and 27 have evidence of implementation.

C_l is interface closure.

Dimensional check for third-party obligation closure: like counts or like quantities cancel, leaving the stated dimensionless fraction, percentage or project screening index.

Engineering interpretation. Five landlord obligations remain open.[372]

Uncertainty and valid range. Evidence strength varies.

What the calculation does not establish. Closure does not guarantee enforceability or performance.

32.45 Heritage, retrofit, temporary, and leased facilities

Non-standard facilities require explicit treatment of constraints and reversible controls.[373]

National heritage law, building regulation, lease conditions and security doctrine can produce different permissible interventions.

The design should identify protected fabric, structural capacity, moisture, reversibility, temporary routes, demountable systems, inspection access and exit strategy.

372 MB-0554. U.S. Department of State, 12 FAM 350.
373 MB-0555. International Organization for Standardization, ISO 19650-5:2020.

Evidence should distinguish permanent work, temporary controls, operating restrictions and conditions for removal or renewal.

A temporary room can become quasi-permanent without the evidence, maintenance and approval expected of a permanent facility.

A successful technical retrofit does not override statutory consent, lease rights or governmental authority.

Heritage, retrofit, leased and temporary spaces require explicit treatment of constraints. Protected fabric, structural capacity, moisture, reversibility, landlord consent, limited possession and uncertain concealed construction can narrow the available solutions. The design should distinguish permanent work, removable inner systems, temporary barriers, operational controls and conditions for renewal or removal.

Temporary use should still have a defined baseline, inspection, test, operating period, maintenance and exit plan. A room that remains beyond its intended term can accumulate unreviewed changes and unsupported assumptions. Where full compliance is impossible, the authority should receive a transparent residual-risk case, not a permanent label derived from a short-term mitigation.

Worked example 32.45. Temporary-facility verified availability

Engineering question. A temporary room operates for 30 days and daily checks pass on 27.

A_t is verified daily availability.

Dimensional check for temporary-facility verified availability: like counts or like quantities cancel, leaving the stated dimensionless fraction, percentage or project screening index.

Engineering interpretation. Three days remain unverified or failed.

Uncertainty and valid range. A daily check can miss intraday change.

What the calculation does not establish. Temporary availability is not permanent accreditation.

32.46 Fire, life safety, accessibility, and conflicting obligations

Security measures must coexist with fire safety, egress, accessibility, structural safety and occupational requirements.[374]

These obligations arise through different national codes and authorities, and the strictest-looking provision cannot simply displace another.

Conflict resolution should identify the requirement, hazard, affected people, technical options, authority owners and verification method.

Coordinated drawings, product evidence, fire and accessibility reviews, functional tests and approved deviations should be retained.

Security-driven seals, locks, thresholds or wall changes can compromise egress, fire resistance or accessibility if treated in isolation.

Only competent authorities can approve departures. Acoustic or security performance cannot excuse unlawful construction.

Security, fire safety, structural safety, accessibility and occupational requirements must be solved together. Door forces, thresholds, locks, seals, wall systems, firestops, alarms and emergency modes can create direct

374 MB-0556. U.S. Department of State, 1 FAM 260, Bureau of Diplomatic Security.

conflicts. The project should identify each competent authority, affected users, hazard, technical alternatives and verification method before a detail becomes fixed.

Conflict resolution should not consist of selecting the numerically greatest requirement. A highly secure lock that obstructs egress is not an acceptable optimum, and an accessible threshold that leaves an uncontrolled gap requires redesign rather than quiet acceptance. Approved departures should preserve rationale, conditions and tests. The final dossier should demonstrate coordinated compliance or authorised residual risk across disciplines.

Worked example 32.46. Conflict-resolution closure

Engineering question. Eleven cross-authority conflicts are logged and eight have signed dispositions.

C_x is conflict closure.

Dimensional check for conflict-resolution closure: like counts or like quantities cancel, leaving the stated dimensionless fraction, percentage or project screening index.

Engineering interpretation. Three conflicts remain visible in the gap register.[375]

Uncertainty and valid range. A disposition can be conditional.

What the calculation does not establish. The ratio does not show which authority controls.

375 MB-0557. U.S. Department of State, 15 FAM 650, Facility Management Support for Major Projects.

32.47 Multinational projects and information release

International projects add originator control, export, contractual and diplomatic release constraints to ordinary design coordination.[376]

Allied organisations may share objectives while retaining different legal authorities, technical standards and dissemination rules.

The project should define a neutral core, country overlays, releasable abstracts, controlled annexes, translation responsibility and dispute escalation.

Every transferred record should carry origin, classification or protection, authorised recipients, purpose, version, checksum and retention instruction.

Over-disclosure can expose vulnerabilities, while under-disclosure can cause incompatible construction or testing.

Release authority belongs to the information owner and relevant governmental process.

Multinational projects should use releasable core records and controlled national annexes. The core can contain room geometry, neutral path identifiers, construction status, measurement data, uncertainty and change history. Each annex can contain local terminology, protected criteria, authority comments, decision rules and release restrictions. This architecture supports cooperation without assuming that every participant may receive every source.

Transfer records should identify originator, marking, authorised recipients, purpose, version, checksum, translation status, retention and further-disclosure rules. A partner's acceptance of data is not necessarily acceptance

376 MB-0558. U.S. Department of State, 12 FAM 010.

of the facility. The release process should check whether combined innocuous records reveal a sensitive architecture and should preserve a record of what each authority actually reviewed.

Table 32-15. Multinational release register

Field	Required entry
Originator	Country, department or organisation controlling release
Recipients	Named organisations and roles
Purpose	Specific design, test or decision task
Content boundary	Included and excluded information
Version and checksum	Exact released object
Retention and destruction	Required lifecycle action

Worked example 32.47. Multinational release minimisation

Engineering question. A package has 200 pages; 54 pages are required for a partner.

M_r is release minimisation.

Dimensional check for multinational release minimisation: like counts or like quantities cancel, leaving the stated dimensionless fraction, percentage or project screening index.

Engineering interpretation. The partner can receive a purpose-built extract rather than the whole dossier.

Uncertainty and valid range. Page count is a crude proxy for sensitivity.

What the calculation does not establish. Minimisation does not authorise the 54 pages.

32.48 Translation, terminology control, and bilingual records

Translation must preserve legal and technical meaning rather than merely produce fluent prose.[377]

English terms used by the United States, United Kingdom and Canada can already differ, while Canadian bilingual records add another controlled-language layer.

A terminology register should retain original term, official translation, source, definition, forbidden equivalents, context and reviewer.

Numerical values, units, abbreviations, classifications, document titles and authority names should be independently checked.

A translation can change obligation, scope or authority even when the sentence remains grammatically elegant.

Unofficial translation should be labelled and should not control a disputed legal or protected requirement.

Translation control should distinguish linguistic accuracy from legal and technical equivalence. Official titles, defined terms, symbols, units, classifications, authority names and clause references should be retained in the original language. A translated explanatory term may aid readers, but it should not replace the controlling text or create a false counterpart in another jurisdiction.

Bilingual and multinational review benefits from a term-level decision log. The log should identify translator, technical reviewer, authority reviewer, context, rejected alternatives and unresolved ambiguity. Numerical tables

377 MB-0559. Office of the Law Revision Counsel, U.S. House of Representatives, 22 U.S.C. section 4852, Diplomatic Construction Program.

deserve independent checking because decimal separators, unit conversions and copied limits can change silently. Where no authoritative translation exists, the record should say so and preserve the original source.

Worked example 32.48. Translation ambiguity rate

Engineering question. A bilingual review finds 6 ambiguous terms in 140 controlled terms.

R_t is ambiguity rate.

Dimensional check for translation ambiguity rate: like counts or like quantities cancel, leaving the stated dimensionless fraction, percentage or project screening index.

Engineering interpretation. Six terms need authority-approved clarification.[378]

Uncertainty and valid range. Reviewers may disagree on ambiguity.

What the calculation does not establish. The rate does not establish an official translation.

32.49 Crosswalk data model, gap register, and update governance

The crosswalk is a controlled dataset, not a static narrative table.[379]

Sources change at different rates, controlled documents may be unavailable to some reviewers, and project decisions can supersede generic guidance.

378 MB-0560. U.S. Department of State, Office of Inspector General, AUD-CGI-20-43, Audit of the Bureau of Overseas Buildings Operations Construction Closeout Process.
379 MB-0561. JCGM 100:2008.

Each cell should carry jurisdiction, topic, source, status, authority, requirement class, evidence, decision, confidence, limitation and last-review date.

The gap register should distinguish unknown, not applicable, controlled, awaiting authority, conflicting and superseded states.

A blank cell, copied value or stale source can silently propagate through specifications and tests.

Automated consistency checks support review, but a competent person must resolve substantive conflicts.

The crosswalk should be implemented as a versioned data model with controlled values and relational links. Core fields include proposition identifier, jurisdiction, topic, source, edition, authority, requirement class, configuration, evidence, decision, confidence, limitation, gap state, owner and review date. Narrative prose should be generated from or reconciled against this dataset so that the two products cannot drift unnoticed.

Gap states should be explicit: resolved, not applicable, controlled, awaiting authority, conflicting, superseded, temporarily mitigated or unexplained. Each state needs an owner, next action, due date and effect on release. Automated checks can identify blanks, stale dates, duplicate terms and broken links, but substantive equivalence and authority decisions remain human responsibilities. The model should preserve prior values rather than overwrite history.

Table 32-16. Crosswalk gap-state taxonomy

State	Meaning	Required action
Resolved	Current source or authority disposition exists	Maintain and monitor

State	Meaning	Required action
Controlled	Answer exists but is not releasable to current reviewer	Link authorised annex
Awaiting authority	Decision requested	Track owner and due date
Conflicting	Sources or authorities disagree	Escalate and preserve alternatives
Not applicable	Scope exclusion is supported	Record rationale
Unexplained	No support or classification	Critical defect requiring triage

Worked example 32.49. Crosswalk update latency

Engineering question. A source changes on day 0 and the crosswalk is updated on day 18.

T_u is update latency.

Dimensional check for crosswalk update latency: time differences and sums retain the stated time unit, while ratios of like times are dimensionless.

Engineering interpretation. The project carried stale information for 18 days.

Uncertainty and valid range. The actual change date may be discovered later.

What the calculation does not establish. Latency does not quantify resulting risk.

32.50 Integrated comparative case study and final evidentiary disposition

A composite multinational project demonstrates how common engineering and local authority overlays operate together.[380]

380 MB-0562. U.S. Department of State, 12 FAM 390.

The hypothetical facility contains Department of State users, an IC mission suite, a British partner area and a Canadian contractor interface in one leased building. None of the room labels or approvals is treated as interchangeable.

The neutral core controls source states, path analysis, construction evidence, measurement, uncertainty and change. Each overlay controls terminology, protected criteria, witnesses, records and decisions.

The assurance disposition requires a complete technical architecture, verified public sources, explicit controlled-document boundaries, native calculations, traceable examples, reconciled objects, accessible presentation, and a fixed-layout examination of the configured evidence.

The case would fail if a single test were presented as multinational approval, if controlled thresholds were reconstructed, or if a later change escaped all four authority routes.

The integrated case should be assessed as four linked approval pathways sharing one physical building. The Department of State suite, IC mission area, British partner space and Canadian contractor interface can share surveys, models and selected measurements, yet each retains its terminology, controlled sources, witnesses, conditions and authority. Shared data should carry configuration identifiers so every recipient can determine whether it describes the space under review.

32.50.1 Facility, mission, and adjoining-access scenario

A hypothetical leased headquarters contains four protected functions within one structurally continuous floor. The first is a Department of State diplomatic meeting suite used for controlled discussions with visiting officials. The second is an Intelligence Community mission area requiring a separate SCIF approval pathway. The third is a British partner room intended for protected conversations under United Kingdom authority. The fourth is a Canadian cleared-contractor collaboration room whose safeguarding, specialised-facility and EMSEC questions remain subject to Canadian departmental and industrial-security processes. The building owner retains the roof, façade, risers, central plant and fire systems, while several software vendors retain remote support access to base-building controls.[381]

The physical survey reveals shared slab edges, a common return-air plenum, adjacent landlord space, a façade maintenance track, a common telecommunications riser and a night ventilation mode that lowers background sound. These facts create a common engineering problem but not a common approval. The project establishes neutral identifiers for every room, boundary, service route, operating state and adjoining access. Each national overlay then records the mission-specific assumptions, controlled criteria, witnesses, documentation and authority decisions that cannot safely or lawfully be merged.

The scenario deliberately rejects the idea that the most restrictive label can be applied to the entire floor. Such an approach would obscure incompatible terminology, produce uncontrolled disclosure, and leave some authorities without evidence in their required form. Instead, the project defines a shared survey and modelling baseline, then partitions requirements by authority and purpose.

381 MB-0563. U.S. Department of State, Office of Inspector General, ISP-I-24-19, Review of the Department of State Physical Security Waivers and Exceptions Process.

32.50.2 Authority map and controlled-document partition

The authority map identifies separate decision chains for diplomatic construction security and accreditation, IC SCIF construction and reciprocal use, British protective-security and counter-eavesdropping review, and Canadian departmental sponsorship, contract security, specialised-facility approval and authority to operate. The landlord, architect, acoustical consultant and commissioning laboratory are evidence producers or duty holders, but none may silently substitute for those governmental decisions. Each decision cell includes its delegating source, named role, required evidence, conditions and review trigger.[382]

The information architecture divides records into a releasable neutral core and controlled annexes. The neutral core contains geometry, path identifiers, material identity, inspection status, test instrumentation, raw acoustic bands, uncertainty and change history. National annexes contain protected criteria, authority comments, sensitive listener assumptions, technical-security findings and approval conditions. A cross-reference token links each annex requirement to the neutral object without reproducing the protected value in the open model.

Release checks examine not only visible text but also drawing layers, model properties, image metadata, comments, revision history, hidden worksheets, embedded files and filenames. Partner packages are generated from the controlled source dataset and receive checksums. This permits each authority to review common evidence while preserving originator control and avoiding independent derivative files that drift apart.

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382 MB-0564. U.S. Department of State, Office of Inspector General, AUD-CGI-20-43, Audit of the Bureau of Overseas Buildings Operations Construction Closeout Process.

32.50.3 Design, procurement, and construction sequence

The neutral design core specifies continuous boundaries, inspectable service interfaces, configuration-controlled doors and glazing, path-separated HVAC, documented penetrations, controlled electronic systems and measurable operating states. It does not insert a universal acoustic or security threshold. Each national overlay attaches its authorised performance requirements, prohibited configurations and evidence expectations to the relevant neutral object. Conflicts with fire safety, accessibility, structure and landlord systems are resolved through coordinated authority review rather than by informal ranking.[383]

Procurement assigns identity and custody controls to critical doors, seals, silencers, glazing components, electronic endpoints, controllers and specialised materials. Substitution requests must identify effects upon acoustic performance, fire listing, network authorisation, EMSEC review, maintenance and evidence provenance. Construction security uses screened personnel, work zones, photography rules, material controls, first-of-type installations and concealed-work hold points proportionate to the governing authority. Missed hold points trigger authorised recovery, not retrospective assumption.

The common return-air plenum becomes the principal coordination challenge. The engineering team develops a shared path model and a neutral closure detail, while each authority receives only the information needed to review its room. The work sequence preserves inspection access before ceilings close, verifies fire and smoke functions, records silencer and

383 MB-0565. U.S. Department of State, 15 FAH-1, Facilities Maintenance Handbook.

barrier identity, and captures photographs and dimensions with controlled location references.

32.50.4 Commissioning, measurement, and decision rules

A shared commissioning plan defines calibrated sources, microphone systems, positions, frequency bands, plant states, doors, masking, electronic modes, background conditions, raw-data formats and uncertainty components. The laboratory and field teams collect reusable measurements under configuration identifiers. They do not write a single multinational pass statement. Instead, each authority or contract applies its own metric, decision rule, guard band, witness and evidence-closure requirements to the common data where method compatibility permits.[384]

The night ventilation state produces lower background sound and reveals greater speech audibility near one return path. A daytime room-average rating would have concealed this condition. The path is localised through controlled source positions, close-range receiving measurements and reversible interventions. The remedial design modifies the return route and support detail, then repeats the affected states. The report preserves before-and-after spectra, uncertainty, excluded paths and the limits of causal attribution.

The British and Canadian authorities request different supporting narratives and protected annex references, while the IC pathway requires its own accreditation evidence. The Department of State suite retains its separate diplomatic-facility process. The common measurement record reduces

384 MB-0566. U.S. Department of State, 15 FAM 680, Facility Operations, Sustainment, Restoration, and Modernization Supplemental Standards.

duplication, but each decision remains bounded to its room, mission, information category, configuration and operating conditions.

32.50.5 Reciprocity, partner release, and authority conditions

One partner proposes accepting the IC room for a temporary multinational meeting because the measured isolation exceeds that of another approved room. The crosswalk rejects this numerical shortcut. The receiving authorities compare mission, information, access, electronic systems, technical-security review, unresolved findings, configuration and use conditions. They may reuse selected data, but they must decide whether the room and proposed activity fall within their authority and release rules.[385]

The reciprocity package therefore contains a controlled delta statement. It lists evidence accepted without repetition, evidence requiring supplementary review, changed conditions, unavailable controlled sources, temporary mitigations and decisions still awaiting authority. The package also records which participants may receive which annex. A favourable technical comparison is presented as evidence of similarity, not as an approval transported across sovereign or departmental boundaries.

Conditional use is recorded as an operational state with enforceable controls: specified participant eligibility, approved electronic equipment, defined plant and masking states, restricted adjoining access, a fixed meeting period, post-use inspection and an expiry time. The conditions remain linked to access systems, booking procedures and incident response. If any condition cannot be sustained, the authority-to-use state reverts automatically rather than relying upon memory.

385 MB-0567. U.S. Department of State, 15 FAM 620, Facility Operations.

32.50.6 Change, incident, and final local-gate disposition

Six months after initial use, the landlord replaces a fan controller and alters night scheduling. The change is inexpensive and outside the protected rooms, yet it changes background and airflow states. The third-party interface register generates a material-change review. Configuration exports, trend logs and repeat measurements show that the acoustic effect is modest but measurable. The relevant authorities receive a bounded impact statement and decide the extent of recommissioning.[386]

During the review, an unexplained cable appears in the common riser. Work stops at the affected interface. The response preserves access records, photographs, cable identity, controller logs and measurement state before removal. Specialist technical-security authorities handle sensitive findings through protected channels, while the construction record receives an authorised disposition. The chapter does not infer malicious cause from the anomaly, and the public release does not disclose exploitable details.

The comparative assurance case closes only when every crosswalk gap has an explicit state, every condition has an accountable owner, every source carries a documented status date, every measurement remains traceable to its method and configuration, every controlled boundary is correctly marked, and the retained evidence supports the stated disposition under the declared operating state. Such closure establishes the intellectual and evidentiary completeness of the comparative analysis, but it neither authorises a real facility nor displaces the competent authorities whose distinct legal, technical, and accreditation processes govern actual use. The

386 MB-0568. U.S. Department of State, Office of Inspector General, AUD-MERO-20-39, Audit of the Bureau of Overseas Buildings Operations Process for Reviewing and Learning From Past Projects.

crosswalk therefore functions as a disciplined instrument of translation and non-equivalence, not as a surrogate approval mechanism.

Chapter 32 Glossary

These definitions are explanatory project terms. Controlling governmental and standards definitions prevail within their own scope.

Accreditation. Formal authority decision concerning a defined facility, purpose, configuration and conditions.

Authority to operate. Written permission to use a facility or system for a defined activity within stated limits.

Common engineering core. Shared physical, metrological and configuration-control requirements independent of one national label.

Controlled annex. Restricted project document linked to the neutral core through stable identifiers.

Crosswalk. Structured comparison of authority, function, source, evidence, decision, lifecycle and limitation.

Decision rule. Predeclared method for deciding conformity from a result, uncertainty and limit.

Diplomatic facility. Facility governed by the relevant foreign-affairs and diplomatic-security authorities.

EMSEC. Measures addressing unauthorised interception of compromising electromagnetic emanations.

Evidence class. Category of evidence such as calculation, test, inspection or authority disposition.

False equivalence. Unsupported claim that two terms, metrics, criteria or approvals are interchangeable.

Gap register. Controlled list of unresolved, controlled, conflicting, inapplicable and awaiting-authority crosswalk cells.

Guard band. Decision margin used to manage conformity risk in view of uncertainty.

Information originator. Authority controlling classification, protection, release and handling of information.

Jurisdictional overlay. Country-specific authority, terminology, criteria, evidence and decision requirements added to a neutral core.

Listener-access model. Spatial and temporal representation of people and positions from which residual speech might be observed.

Material change. Change capable of affecting evidence, authority conditions or the protected state.

Measurand. Quantity intended to be measured, defined sufficiently for reproducibility.

Need-to-know. Requirement that access to information be necessary for authorised duties in addition to eligibility.

Neutral functional description. Project description of protected activity and consequence that does not replace official terminology.

Non-equivalence rule. Rule prohibiting automatic conversion among national terms, metrics, documents and decisions.

Operational requirement. Authorised statement of security need, threat, function and constraints before solution selection.

Originator control. Requirement that the information owner govern release and downstream handling.

Protected criterion. Requirement whose details are not publicly releasable to all project participants.

Reciprocity. Authority recognition of another authority decision under stated conditions.

Recommissioning. Repeat or targeted verification after change, incident, degradation or elapsed time.

Residual risk. Risk remaining after controls and corrective action, subject to authorised disposition.

SCIF. Sensitive Compartmented Information Facility under the applicable United States Intelligence Community framework.

Secure Room. United Kingdom term generally associated with protected storage and not automatically equivalent to a Secure Working Area or speech environment.

Secure Speech Environment. United Kingdom public service term for an environment intended to support protected discussion under competent authority.

Secure Working Area. United Kingdom area where sensitive information or assets are handled by personnel.

Source freeze. Date at which source identity, status and accessibility are captured for a release.

Source hierarchy. Relationship among law, policy, standard, specification, contract, guidance and authority decision.

Source state. Defined speech, equipment and operating condition used for analysis or test.

Speech privacy room. Canadian specialised secure-facility term identified in public contract-security guidance.

TCR. Department of State treated conference room, a term with specific diplomatic-security meaning.

TEMPEST. Name associated with specifications and controls for limiting compromising electromagnetic emanations.

True footnote. Native Word footnote linked by an in-text reference and stored in the footnotes part.

Uncertainty budget. Structured inventory and combination of measurement-uncertainty components.

Unresolved cell. Crosswalk field lacking a current source or authorised decision.

Use condition. Restriction attached to an approval or authority decision.

Whole-envelope analysis. Assessment of direct, flanking, structural, service, equipment and operational paths.

Zone. Controlled spatial area whose institutional meaning depends upon the governing national framework.

PART IX. DESIGN, PROCUREMENT, AND CONSTRUCTION CONTROL

Part IX establishes the documentary and physical chain by which a protected-room requirement becomes an installed and reviewable configuration. Chapter 33 governs design basis, procurement, evidence, commercial controls, reviewer responsibility, and acceptance. Chapter 34 then governs construction surveillance, concealed-work proof, nonconformance, as-built reconciliation, and lifecycle evidence.

Chapter 33. Basis of Design, Room Data Sheets, Specifications, Procurement, and Submittal Review

33.1 From protected function to project requirement

A secure room cannot be procured from a single adjective. Terms such as “soundproof”, “government grade”, “SCIF quality”, “acoustic”, “high security” and “confidential meeting room” fail to identify the protected function, source state, receiving positions, physical paths, electronic systems, authority or evidence needed for acceptance. The first project obligation is therefore to convert the authorised use into a traceable body of requirements. That conversion begins before wall types are selected and continues through commissioning, handover and later change.[387]

The requirements should distinguish the four propositions already established in this volume; a laboratory assembly requirement addresses a tested specimen; a field requirement addresses the installed room pair or element; an occupied speech-security requirement addresses source, room, boundary, background and listener access. Formal approval remains with the competent authority. When these propositions are written in one undifferentiated sentence, the contractor cannot know what must be supplied and the authority cannot know what the evidence proves.

A strong project requirement identifies its owner, source, rationale, technical response, verification method and final disposition. It also records constraints imposed by structure, fire safety, accessibility, environmental control, heritage, operations, information systems and maintenance. Secure-room design is therefore a process of coordinated evidence rather than a late acoustic annotation to an architectural plan.

387 MB-0569. U.S. Department of State, 12 FAM 310.

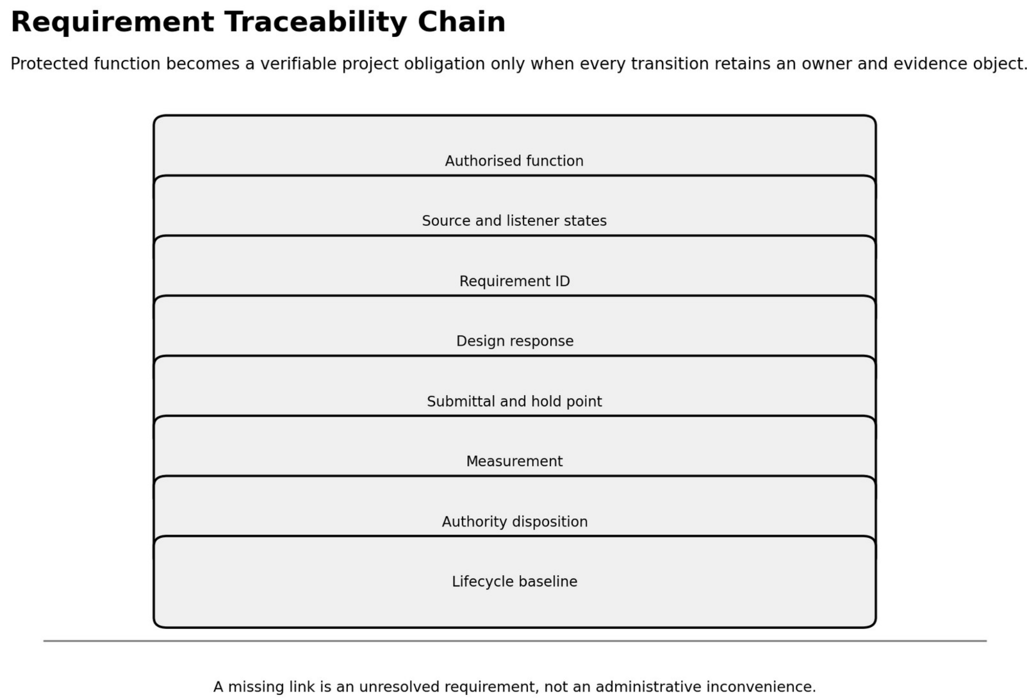

Figure 33-1. Requirement traceability converts protected function into verifiable project evidence. Author's original diagram.

Worked example 33.1. Converting an adjective into a requirement

A brief states, "Provide a soundproof meeting room." The design team replaces this with five propositions: a defined laboratory basis for walls, doors and glazing; a field airborne-isolation requirement under a named method; an occupied maximum-effort speech test at identified listener positions; a controlled background and masking state; and a final authority decision. The revised brief is longer, but every clause now has an evidence object.

33.2 Owner's project requirements

The owner's project requirements establish why the room exists and what conditions the completed project must support. They should describe the authorised activities, information categories, users, occupancy, duration, equipment, operating modes, surrounding access, expected life, maintenance model and decision authority. They should also state which conditions are deliberately excluded. A room authorised for local oral discussion should not be assumed suitable for video conferencing, equipment storage or continuous classified processing.

The owner's requirements should distinguish fixed outcomes from design preferences; a required speech-security outcome is an outcome; a preferred wall thickness is a design preference unless structural or spatial constraints make it mandatory; this distinction preserves design flexibility while preventing a contractor from substituting away a critical mechanism.

Uncertainty should be visible from the outset; early project data may contain ranges rather than final values; the requirement register should mark each value as confirmed, provisional, assumed or controlled; assumptions carry owners and closure dates. An unclosed assumption about adjoining occupancy or loudspeaker output can invalidate later calculations even when drawings are complete.

Worked example 33.2. Assumption maturity index

A basis contains 25 critical inputs. Fifteen are confirmed, six are provisional with owners and four are unassigned assumptions. Assign maturity weights of 1.0, 0.6 and 0.0. The maturity index is

$$M = \frac{15(1.0) + 6(0.6) + 4(0)}{25} = 0.744.$$

The 74.4 per cent result is a management indicator, not a probability of success. It directs attention to the four ownerless assumptions before design freeze.

33.3 Threat, use and source-state basis

The design basis should identify the credible source states that the room must contain. Ordinary speech, maximum unamplified vocal effort, speakerphone output, presentation loudspeakers, emergency public-address sound and maintenance tests can produce materially different spectra and levels. The requirement should also identify source positions and orientations, because a talker near glazing or a loudspeaker fixed to a wall can excite paths differently from a central source.

The receiving model is equally important. It records accessible corridors, offices, risers, ceiling voids, roofs, façades, adjoining tenants, external positions and maintenance spaces. It should distinguish continuous access from intermittent or escorted access, and unaided listening from recording or technical collection where authorised threat analysis requires it.

A threat basis is not a catalogue of adversary imagination. It is an authorised, proportionate description of the source-path-receiver conditions against which the project will be designed and tested. Unsupported extreme scenarios distort cost, while understated scenarios create false assurance.

Worked example 33.3. Source-state envelope

Three credible source states have band levels of 67, 73 and 79 dB. Design based on the arithmetic mean, 73 dB, would understate the highest credible state by 6 dB. The basis therefore uses the 79 dB state for containment screening and identifies its duration and spectrum. It does not assume that every meeting continuously produces that level.

33.4 Requirement traceability matrix

The requirement traceability matrix is the project's central control instrument. Each row contains a stable identifier, source, exact requirement, rationale, responsible discipline, design response, drawing or specification reference, submittal, inspection point, test, acceptance rule, authority and status. The matrix should survive software changes and remain readable without specialist database access.

Traceability prevents several common failures. A requirement can disappear between the security brief and the architectural specification; a detail can be drawn but not inspected; a test can be performed without a criterion; a criterion can be met without authority disposition. The matrix makes each discontinuity visible.

Rows should be divided when they contain different evidence; "provide STC 60 walls, acoustic doors and secure speech performance" is not one requirement; it contains at least three different objects, methods and acceptance steps; granularity should follow the proof burden rather than administrative convenience.

Table 33-1. Requirement-traceability fields

Field	Required entry	Evidence role	Common defect
Requirement identifier	Stable code	Supports references and change history	Renumbered rows lose provenance
Source and owner	Issuer and responsible person	Establishes authority	No one owns closure
Technical proposition	Precise outcome or control	Defines the object	Several propositions merged
Design response	Drawing, specification or calculation	Shows implementation	Narrative response without location

Field	Required entry	Evidence role	Common defect
Verification	Submittal, inspection or test	Defines proof	Final test expected to reveal hidden work
Decision rule	Criterion, uncertainty and disposition	Supports conformity	Rule invented after results
Lifecycle trigger	Maintenance or change condition	Preserves validity	Handover treated as permanent closure

Worked example 33.4. Traceability closure

A matrix has 120 rows. Ninety-five have complete design, verification and disposition fields; 18 lack verification; seven lack authority disposition. The administrative closure rate is 79.2 per cent, but the project remains open because 25 controlling rows are incomplete. Percent completion does not override criticality.

33.5 Basis of design

The basis of design explains how the project team interprets the owner's requirements and why the selected systems can satisfy them. It should state the acoustic model, source spectra, room geometry, paths, material assumptions, flanking allowances, background conditions, masking philosophy, service strategy, testing methods and uncertainty approach. It should identify the standards used and their editions.

The document must be more than a list of products. It should describe mechanisms. A double-stud wall is selected because structural decoupling and cavity depth are required; an independent lining is selected because the host masonry cannot be altered; a sound lock is selected because one operable opening would dominate; a duct silencer is selected because the branch path controls. Mechanistic reasoning supports review and later substitution decisions.

The basis should also state limitations. Prediction methods may be reliable in one frequency range and weak in another. Manufacturer data may not match field dimensions. Existing construction may be inaccessible. A public source may not disclose a controlled criterion. These limitations become project actions rather than hidden uncertainty.

Worked example 33.5. Path budget in the basis of design

Predicted receiving contributions are wall 25 dB, door 31 dB, duct 28 dB and slab flank 30 dB relative to the chosen reference. Linear combination gives a total near 33.9 dB. The wall is not the governing path. The basis allocates improvement to the duct and door before adding more wall mass.

33.6 Room data sheets

A conventional room data sheet records area, occupancy, finishes and services. A secure-room data sheet must also record authorised use, information category, source states, adjoining spaces, listener access, wall and opening systems, HVAC topology, penetrations, electronics, masking, access control, operating modes, maintenance constraints, inspection points, tests and change triggers. It is a concise operational specification for one room.

The sheet should include a plan thumbnail with stable coordinate references so that penetrations, doors, glazing, microphones and measurement positions can be identified consistently. Adjoining-space use should be recorded by side, floor and ceiling. Where future tenancy is uncertain, the sheet should state the conservative assumption and review trigger.

Room data sheets should not reproduce controlled criteria in documents distributed beyond authorised recipients. A public or contractor-facing sheet can use requirement identifiers that refer to controlled schedules held separately. This separation preserves both coordination and information control.

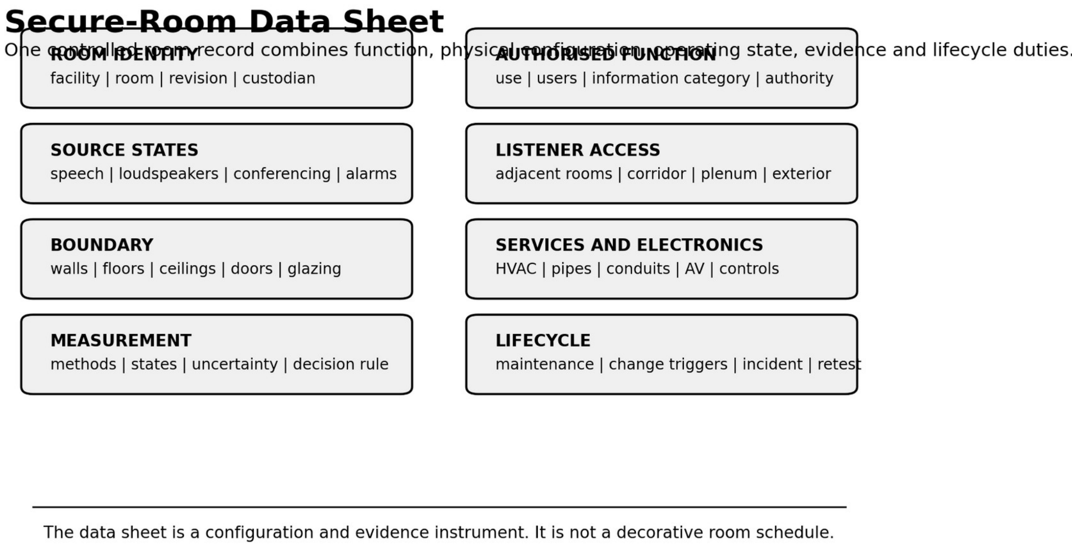

Figure 33-2. A secure-room data sheet records functional and evidentiary conditions, not merely finishes. Author's original diagram.

Worked example 33.6. Data-sheet completeness

A secure-room sheet has 32 mandatory fields. Twenty-eight are complete, two are provisional and two are blank. If provisional fields count as half, completeness is

$$C=\frac{28+2(0.5)}{32}=0.906.$$

The 90.6 per cent value does not permit design freeze because the blank fields concern adjoining access and maximum loudspeaker level.

33.7 Performance specifications

A performance specification states the required result while allowing the contractor or delegated designer to select means within controlled boundaries. For acoustic work, it should identify the measurand, frequency range, test method, source and receiving condition, background correction, uncertainty, decision rule, sample size and responsible laboratory. “STC 55 wall” is insufficient when the project requires field or speech-security performance.

Performance requirements should be located at the system level that will be accepted; a laboratory wall requirement belongs in the partition section and submittal schedule; a room-pair field requirement belongs in the commissioning or acoustic testing section. A closed-room speech-security requirement belongs in the whole-room acceptance plan; mixing them in one paragraph obscures responsibility.

A performance specification must also define what happens when the result is not achieved. The contract should preserve access for diagnosis, require correction and retest, allocate costs and protect evidence. Without a remedial framework, a failed test becomes a negotiation rather than a controlled engineering process.

Worked example 33.7. Frequency-range omission

A specification requires “field isolation 50 dB” without frequency range. One bidder assumes a single-number rating; another assumes 125-4000 Hz band values; a third excludes low bands. Bids are incomparable. The corrected requirement names the standard, quantity, frequency range and reporting of raw bands.

33.8 Prescriptive specifications

Prescriptive requirements define materials, geometry, sequencing or workmanship where the mechanism must be preserved. Secure construction often needs both performance and prescription. A wall may have a field requirement and still require independent framing, minimum cavity, specified board layers, no back-to-back boxes, continuous perimeter seal and inspection before closure.

Prescription is justified when later testing cannot reveal the hidden condition uniquely or when other obligations such as fire resistance, structural support, moisture, durability or searchability depend on the detail. It should not freeze unnecessary brand preference. The specification should state which characteristics are essential and which alternatives may be reviewed.

Prescriptive clauses should coordinate with tested listings. Changing fasteners, framing, sealants or service arrangements can affect acoustic and fire performance. The project team should not create a hybrid assembly by combining favourable details from unrelated tests without evidence.

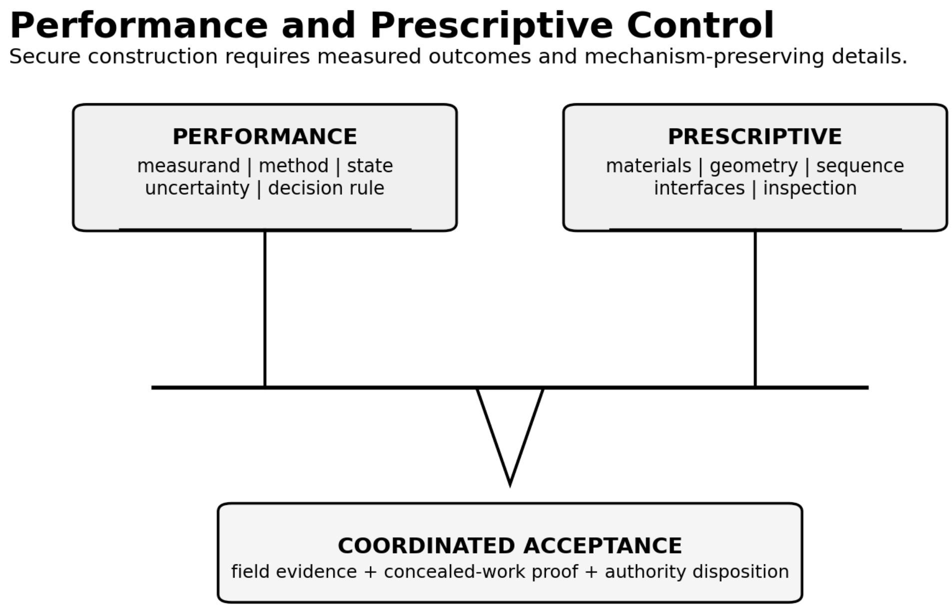

Figure 33-3. Secure construction usually requires both performance and prescriptive controls. Author's original diagram.

Worked example 33.8. Necessary prescription

A field requirement can be met by several wall systems, but the room contains high-risk recessed electronics. The specification adds a prescriptive prohibition on back-to-back boxes and requires surface raceways in a controlled service zone. The prescription protects searchability and boundary continuity beyond the headline field result.

33.9 Specification organisation and interfaces

Secure-room requirements cross architectural, structural, mechanical, electrical, communications, fire-protection, security and commissioning sections. The project should place requirements where the responsible trade will price and execute them, while using cross-references and a common boundary schedule to preserve integration. Repeating the same clause in many sections creates version conflict.

An interface matrix identifies elements controlled by more than one section: door frame to wall, glazing to façade, duct to silencer, pipe to firestop, cable tray to penetration, display mount to independent lining, raised floor to partition and ceiling to wall head. Each interface has a lead detail, contributing sections and inspection owner.

Specification numbering systems such as MasterFormat can organise work results, but the classification system does not solve technical coordination. The project must still define system boundaries and assign integration responsibility.[388]

Worked example 33.9. Interface count

Eight major systems each interact with an average of four others. Counting undirected interfaces gives approximately

$$I = \frac{8(4)}{2} = 16.$$

The estimate shows why interface management cannot be left to informal shop-drawing review. Actual interfaces are then listed individually.

33.10 Drawings, schedules and details

Drawings communicate geometry and location more effectively than prose. Secure-room drawings should show boundary extents, wall heads, bases, corners, intersections, doors, glazing, services, raised floors, ceilings, structural joints and inspection access. Details should identify primary air seals and resilient separations, not conceal them behind generic notes.

Schedules should preserve configuration. A door schedule records leaf, frame, seals, threshold, hardware, fire and smoke status, test report and

388 MB-1106. Office of the Director of National Intelligence, Intelligence Community Directive 705, Sensitive Compartmented Information Facilities.

maintenance. A penetration schedule records location, service, sleeve, seal, firestop, acoustic treatment, inspection and change history. A glazing schedule records pane build-up, interlayer, cavity, frame, gaskets, size and test basis.

The detail set should avoid contradictory scale. A generic plan note stating "seal all penetrations" does not correct a section detail showing an open sleeve. The project's digital coordination process should flag requirements that appear only in notes and not in details.

Worked example 33.10. Detail coverage ratio

A boundary inventory identifies 42 distinct interface types; thirty-five have dedicated or referenced details; the detail coverage ratio is 83.3 per cent; the seven uncovered interfaces include two high-risk service transitions, so the set remains incomplete despite the high ratio.

33.11 Information management and document control

Secure projects generate controlled and public information with different access conditions. Information management should assign classification or sensitivity, author, reviewer, revision, status, distribution, retention and checksum. Model and document exchanges should follow an agreed naming and approval process. ISO 19650 concepts can support structured information management, but project security rules govern access and dissemination.[389]

Drawings issued for coordination should not be mistaken for construction release; submittal status should distinguish reviewed, approved as noted, rejected, informational and controlled; superseded files must remain

389 MB-1108. Office of the Director of National Intelligence, Intelligence Community Standard 705-1, Physical and Technical Security Standards for SCIFs.

traceable without appearing current; site teams need reliable access to the authorised version, including controlled details where permitted.

The common data environment should record who changed what and when. A secure-room project cannot rely on filenames such as “final-final-revised”. Stable metadata and checksums make later forensic review possible.

Worked example 33.11. Revision collision

Two contractors use different files both labelled Revision 4. Checksums show they differ. One contains a revised wall-head detail; the other does not. The document-control system suspends work, identifies the authorised issue and records the affected installed locations for inspection.

33.12 Procurement strategy

Procurement strategy determines how design responsibility, specialist expertise, pricing risk and evidence are allocated. Traditional design-bid-build can preserve owner control of details but requires complete documents before tender. Design-build can integrate fabrication knowledge but risks deferred criteria and performance gaps if the owner’s requirements are vague. Construction management can support early specialist engagement but requires disciplined package interfaces.

The project should decide which secure systems are fully designed, performance specified, delegated or proprietary. Delegated design requires clear loads, interfaces, performance, submittals, qualifications and professional responsibility. Proprietary specification may be justified for controlled or uniquely tested systems, but sole-source decisions should be documented and coordinated with procurement law or policy.

Long-lead items such as acoustic doors, specialised glazing, silencers and secure electronics should be identified early. Schedule pressure is a common cause of unreviewed substitution.

Worked example 33.12. Procurement risk allocation

A specialist doorset has a 28-week lead time. The project schedule allows only 20 weeks after final submittal. The 8-week deficit is identified during procurement planning, prompting early-release design and mock-up rather than a late lower-evidence substitution.

33.13 Contractor and specialist qualifications

High-isolation construction is workmanship-sensitive. Qualifications should be proportional to the work and evidence required. The specification may require experience with comparable assemblies, trained installers, manufacturer authorisation, accredited laboratories, qualified acoustical consultants, firestop inspectors and documented quality systems.

Experience should be verified rather than asserted; a list of projects does not prove responsibility or performance; references should identify scope, date, system, role and outcome; qualifications should not create unnecessary barriers unrelated to risk, but neither should the project assume that ordinary fit-out experience covers resilient isolation, specialised seals or controlled construction.

The project should also identify competent supervision. A qualified firm can still fail if critical work is delegated to untrained labour without oversight.

Worked example 33.13. Qualification scoring

A tender evaluation assigns 30 points to comparable completed work, 25 to named personnel, 20 to quality-control plan, 15 to test and commissioning experience and 10 to references. A bidder scoring 82 exceeds the threshold of 75. The score supports procurement judgement but does not guarantee future workmanship.

33.14 Bid documents and scope clarity

Tender documents should disclose enough information for comparable pricing while protecting controlled details. Bidders need boundary extents, system types, performance requirements, inspection obligations, submittals, mock-ups, testing, access restrictions, schedule and correction responsibilities. Ambiguity invites qualifications and later claims.

A bid form can separate high-risk alternates and unit prices. Examples include additional penetrations, after-hours inspection, destructive investigation, retesting and replacement seals. Unit prices should not encourage unnecessary work, but they reduce dispute when quantities change.

Pre-bid meetings should address security handling, access, photography, device restrictions, escorted work and information dissemination. These requirements affect productivity and must be priced honestly.

Worked example 33.14. Bid normalisation

Three bids are 10.0, 9.6 and 9.2 million units. The lowest excludes mock-up testing worth 0.5 and controlled escort costs of 0.4. Normalised cost becomes 10.1, making it no longer lowest. Scope comparison prevents apparent savings from becoming project risk.

33.15 Submittal schedule

The submittal schedule should be written before procurement and tied to the requirement matrix. It identifies product data, complete laboratory reports, shop drawings, calculations, samples, mock-ups, certificates, installation procedures, inspection plans, test plans, maintenance data and as-built records. Due dates reflect review and resubmission, not merely delivery.

Submittals should be grouped by decision. A wall package includes framing, board, absorber, sealants, fire and structural interfaces and relevant tests. Receiving isolated product sheets from separate trades prevents system review. The schedule should identify prerequisites, such as approval of the rough opening before final door fabrication.

The project should also state whether submittals become part of the contractual configuration baseline. Approved substitutions and shop drawings must flow into as-built records.

Worked example 33.15. Review-cycle duration

A critical submittal allows 15 days for contractor preparation, 14 for design review and 7 for resubmission, with two likely cycles. Total planning duration is

$$T = 15 + 14 + 7 + 14 + 7 = 57\,\text{days}.$$

A schedule allowing 20 days is unrealistic and creates pressure for conditional fabrication.

33.16 Product data versus complete evidence

Product data identify dimensions, materials and options. They rarely establish the complete tested configuration. A compliant acoustic submittal should include the full test report, specimen description, drawings, mounting, laboratory, method, date, frequency data, rating, deviations and limitations. Summary sheets are insufficient where substitutions or field applicability must be assessed.

The reviewer should compare the test specimen with the proposed assembly attribute by attribute. Differences in size, framing, seals, hardware, cavity, support, finishes and interfaces are recorded. Some differences are benign; others require engineering analysis, mock-up or new testing.

The evidence hierarchy becomes progressively project-specific, from product identity to full report, shop drawings, mock-up, installed inspection and field test.

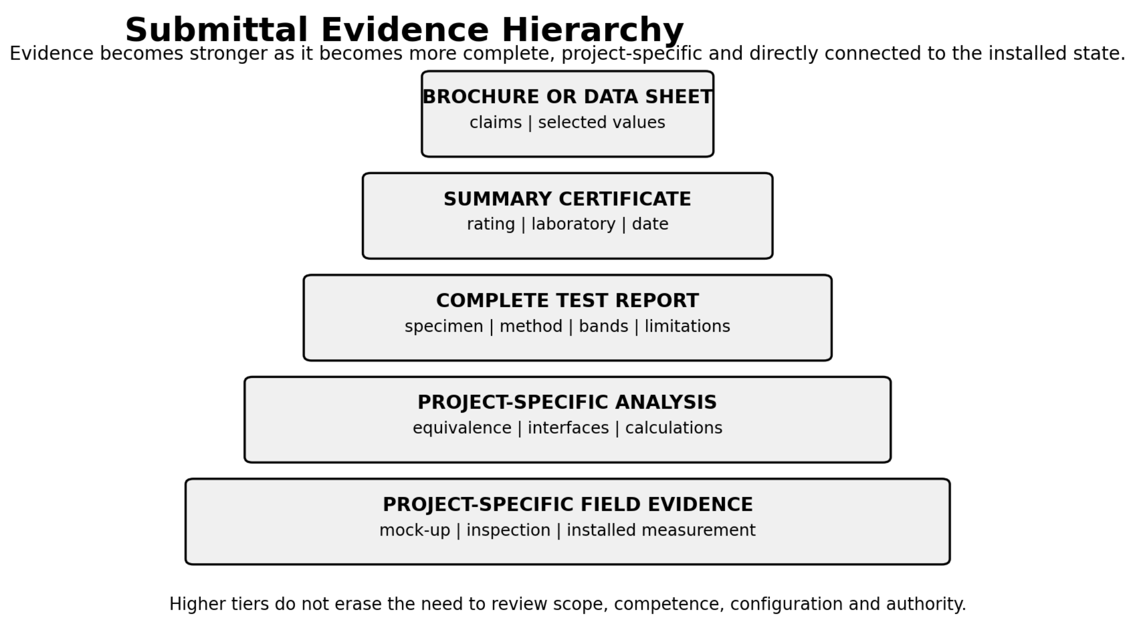

Figure 33-4. Submittal evidence becomes progressively more project-specific. Author's original diagram.

Worked example 33.16. Report completeness

A test summary lists STC 58 but omits specimen dimensions, mounting and band values. The project requires seven report elements; only two are present. The submittal is returned as incomplete rather than reviewed for technical acceptability.

33.17 Shop drawings

Shop drawings translate design intent into fabrication and installation. They should show dimensions, joints, supports, anchors, clearances, seals, tolerances, service interfaces, hardware, access and sequence. They should not merely copy design drawings with a contractor title block.

Review should focus on interfaces and deviations. The design professional does not assume the contractor’s means and methods, but must identify departures from the specified performance and configuration. Controlled details may require restricted review channels.

Three-dimensional coordination can reveal collisions, but model clearance does not prove acoustic continuity. The shop drawing should show the primary seal and structural path explicitly.

Worked example 33.17. Tolerance stack

A door opening has wall tolerance ±4 mm, frame fabrication ±2 mm and installation position ±3 mm; worst-case linear stack is 9 mm; if the seal adjustment range is only 6 mm, the design lacks tolerance; statistical combination may be smaller, but secure closure should not depend on favourable accumulation without evidence.

33.18 Samples and mock-ups

Samples show appearance and material identity. Mock-ups show interfaces, sequence and workmanship. A secure-room mock-up should include representative corners, heads, bases, penetrations, services, door or glazing interfaces and finishes. It should be large enough to expose practical installation issues.

The mock-up is reviewed before repetitive work; defects are corrected, details frozen and lessons incorporated into drawings and training; when appropriate, acoustic or air-leakage tests establish whether the assembly behaves as intended; the mock-up itself becomes a reference standard and should be protected or thoroughly documented.

A mock-up that omits the difficult interfaces is ceremonial rather than evidentiary.

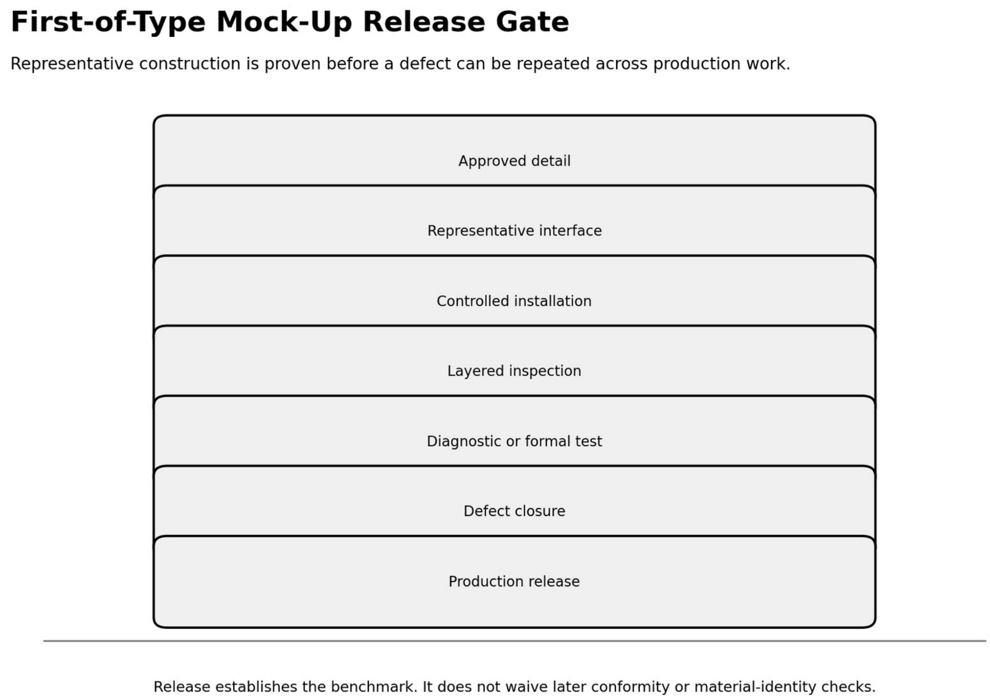

Figure 33-6. A first-of-type mock-up is a construction-release gate. Author's original diagram.

Worked example 33.18. Mock-up defect multiplication

A first-of-type wall reveals three defects. If the project has 80 similar rooms and the detail were repeated unchanged, potential defect instances could reach 240. Correcting the mock-up before release avoids multiplication, though actual field frequency would depend on workmanship and sampling.

33.19 Delegated design

Delegated design assigns detailed engineering of a system to a contractor or specialist while the owner's design team defines criteria and interfaces. It can be appropriate for doorsets, curtain walls, silencers, isolated ceilings, supports and proprietary enclosures. It fails when the delegation is implicit or the criteria are incomplete.

The specification should state loads, dimensions, movements, environmental conditions, acoustic quantities, test methods, fire and security requirements, connection limits, submittals, calculations, professional sealing where required and coordination responsibilities. The delegated designer should identify assumptions and deviations.

Review of delegated design is not a transfer of all responsibility back to the reviewer. The contract should preserve the specialist's design responsibility while enabling the owner's team to confirm conformance with the project criteria.

Worked example 33.19. Delegated-design load case

An isolated ceiling is delegated. The criteria include self-weight, 0.25 kPa service load, seismic restraint, 50 mm service deflection clearance and a target natural frequency. Omitting the service load would allow a hanger selection that passes acoustic calculation but fails in use.

33.20 Substitutions

Substitution review compares function, mechanism, interfaces and evidence. Equal rating is only one field. The proposed item must be compared for dimensions, mass, stiffness, damping, fire, smoke, structure, environmental durability, hardware, maintenance, test configuration, frequency response, installation and compatibility.

The request should identify the reason, cost and schedule effect, complete evidence and affected documents; the reviewer should not reconstruct missing evidence under deadline pressure; where equivalence remains uncertain, a mock-up or test may be required; the competent authority should review substitutions affecting controlled criteria or accepted configuration.

Substitutions made in the field without documentation are nonconformances, even if the product appears superior.

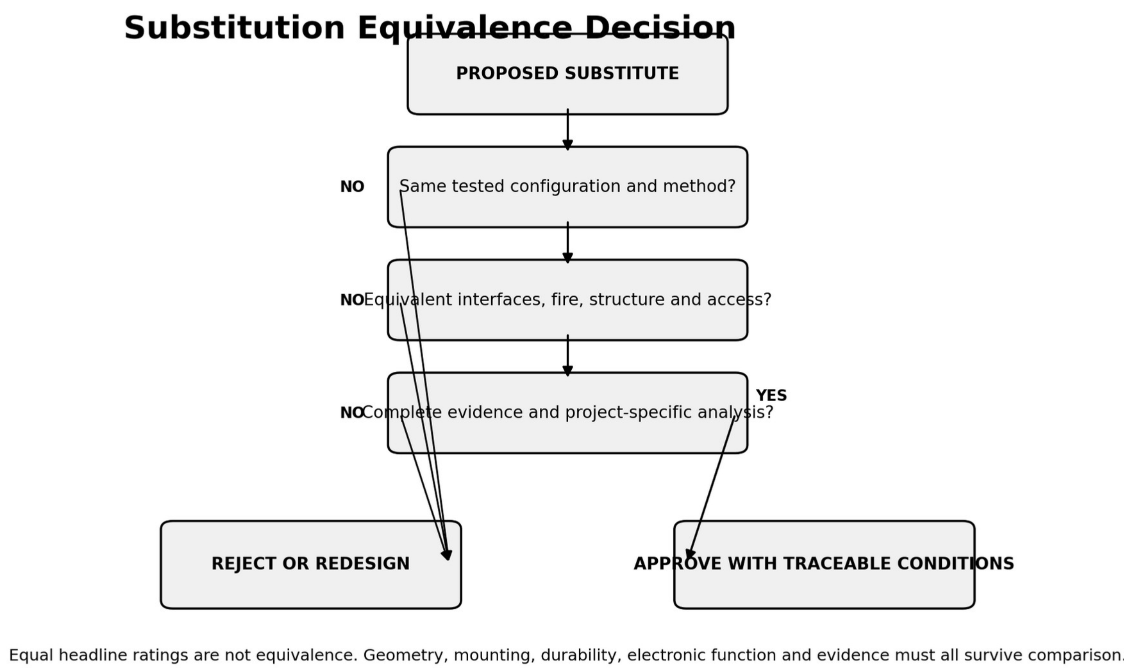

Figure 33-5. Equal headline ratings do not establish substitution equivalence. Author's original diagram.

Worked example 33.20. Multi-attribute equivalence

A proposed door matches laboratory rating and size but differs in frame profile, automatic bottom, latch and fire label. Of eight critical attributes, four match. The request is not rejected solely by the score, but the unmatched interfaces require evidence before approval.

33.21 Request for information control

A request for information should clarify the contract, not redesign the secure boundary through a chain of informal emails. Each RFI receives a stable identifier, exact location, question, proposed interpretation, affected requirements, urgency, response and drawing or specification change. Verbal answers are recorded formally before work proceeds.

RFIs involving controlled information require authorised handling. The public field question can identify a requirement code and location while the controlled response provides the restricted detail. This separation allows construction coordination without unnecessary dissemination.

Repeated RFIs on one detail can signal defective documents or training rather than contractor confusion. Trend analysis should feed the quality plan and mock-up programme.

Worked example 33.21. RFI trend threshold

A project has 60 RFIs. Twelve concern wall heads, though wall heads represent only 5 per cent of detail types. The disproportionate frequency triggers a design and training review rather than twelve isolated responses.

33.22 Nonconformance and corrective action

A nonconformance record identifies the requirement, observed condition, location, evidence, immediate control, technical evaluation, proposed correction, authority, reinspection and closure. It should distinguish repair, use-as-is, replace and redesign dispositions. “Contractor to fix” is not an adequate record.

Corrective action should address cause as well as symptom. An unsealed penetration may result from missing detail, poor training, inaccessible sequence or deliberate shortcut. Repairing one location without correcting the process permits recurrence.

Use-as-is dispositions require engineering and authority review. A condition should not be accepted merely because demolition is inconvenient. The record states residual effect, uncertainty and lifecycle implications.

Worked example 33.22. Recurrence probability screen

Ten sampled penetrations contain three defects. Under a simple independent model, the estimated defect proportion is 0.30. Even without formal statistical inference, the result is too high to justify inspecting only the three failures. The project expands inspection and investigates the installation process.

33.23 Inspection hold points

Hold points prevent concealment before required evidence is collected. Typical secure-room hold points include framing before boarding, resilient components before loading, wall heads before ceiling closure, penetration sleeves before firestop, firestop before finishes, door-frame anchors before grout or trim, glazing perimeters before covers, duct silencers before ceiling closure and electronics before commissioning.

Each hold point has entry conditions, required attendees, checklist, photographs, measurements, allowed dispositions and release authority. Work does not proceed merely because an inspector is unavailable. The schedule should provide notice periods and contingency.

Witness points differ from hold points. At a witness point the contractor may proceed after notice if the reviewer does not attend, depending on the contract. The distinction should be explicit.

Worked example 33.23. Hold-point capacity

A project has 180 planned hold points over 30 weeks, averaging six per week. The inspection team can reliably process four per week. The two-per-week deficit is resolved by adding qualified staff and consolidating repetitive first-of-type reviews; otherwise schedule pressure would encourage unobserved closure.

33.24 Test plans

The test plan identifies objects, methods, equipment, calibration, source and receiver locations, operating states, sample selection, background limits, uncertainty, decision rules, raw data, reporting and failure response. It is reviewed before testing, not written afterward to match the result.

Testing should be staged. Component or mock-up testing reduces design risk; pretests identify gross defects while access remains; formal acceptance testing occurs under controlled final conditions; diagnostic testing follows failure and may use different methods. Retesting confirms repair without erasing the original record.

The plan should identify who may direct changes during testing. Informal adjustment can invalidate the configuration. If a door seal is tuned or masking level changed, the action, time and resulting test sequence are recorded.

Worked example 33.24. Sample allocation

A project contains 40 similar rooms. The authority requires testing of the first two, every tenth room thereafter and any room with major nonconformance. The base sample is 2 + 4 = 6 rooms, before risk additions. The plan identifies the selection rule before results are known.

33.25 Measurement uncertainty and acceptance language

A specification should state how uncertainty affects conformity. The measured value, standard uncertainty, coverage factor and decision rule are separate fields. Phrases such as “meet or exceed” do not reveal whether a guarded result is required. The rule should be selected according to consequence and contract, not after test results arrive.[390]

Configuration uncertainty should also be addressed. The test record confirms doors, HVAC, masking, furniture, electronics, room pressure and adjoining occupancy. These are not all captured by instrument calibration. A repeatable number obtained in the wrong state is not acceptable evidence.

The acceptance language should distinguish pass, fail, conditional acceptance, retest and authority disposition. Conditional acceptance has an expiry or closure condition.

Worked example 33.25. Guarded field result

A measured result is 47.0 dB with expanded uncertainty of 1.4 dB; a lower-guarded criterion requires 46 dB; the decision quantity is 45.6 dB, so the result does not pass; the report preserves both the measured estimate and the decision outcome.

33.26 Acceptance matrix

The acceptance matrix links each controlling requirement to submittal, inspection, test and authority evidence. It provides a compact view of open items without reducing criticality to a percentage. A room should not be released while a controlling cell remains open, even when most rows are complete.

390 MB-1109. Office of the Director of National Intelligence, Intelligence Community Standard 705-2, Standards for Accreditation and Reciprocal Use of SCIFs.

The matrix should differentiate technical acceptance by the design team, contractual acceptance by the owner and security authorisation by the competent authority. These may occur at different times. The project may achieve substantial completion while security use remains restricted.

Cells should reference records rather than contain untraceable comments. “OK” is replaced by report number, date and disposition.

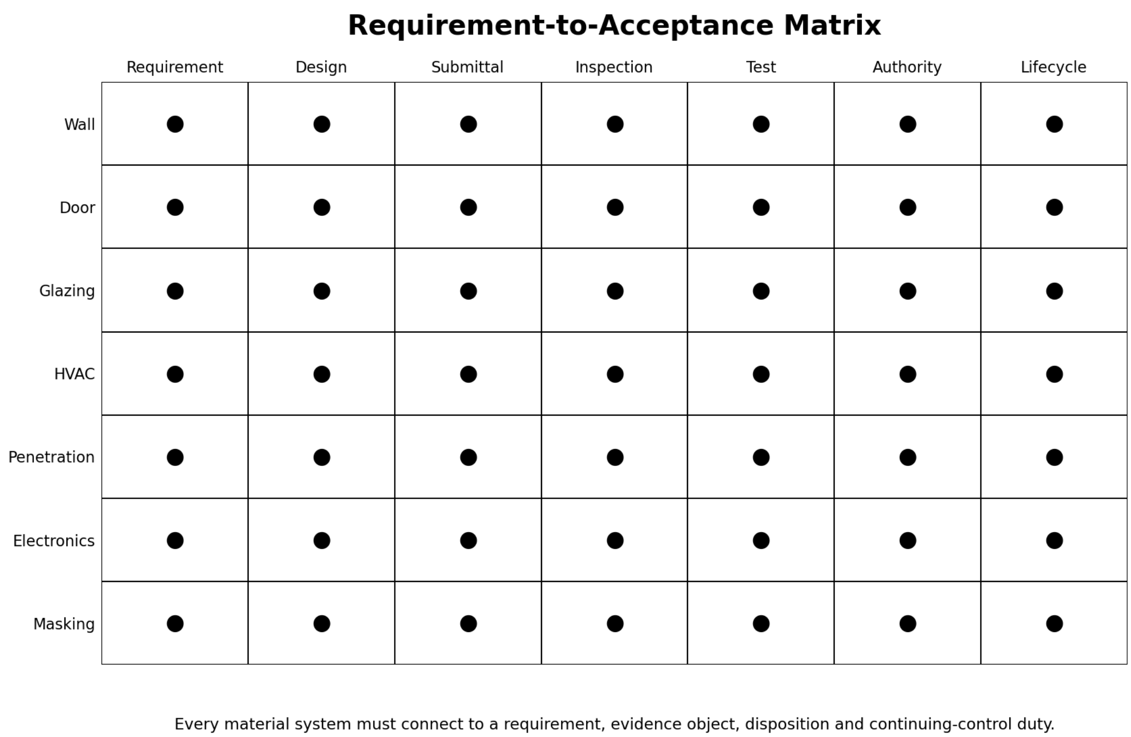

Figure 33-7. The acceptance matrix links every requirement to evidence and disposition. Author’s original diagram.

Worked example 33.26. Critical open cell

A matrix has 98 per cent of cells closed; the remaining open cell is the whole-room speech-security test; the project is not ready for sensitive use; the high completion percentage is irrelevant to the missing controlling evidence.

33.27 Commissioning requirements

Commissioning verifies that systems are installed, adjusted, documented and operated as intended. Secure-room commissioning integrates acoustic, mechanical, electrical, audiovisual, controls, access, masking and technical-security functions. It should begin during design with commissioning requirements and testability review.[391]

The commissioning plan identifies systems, responsibilities, prefunctional checks, functional tests, seasonal or mode tests, deficiencies, retests, training and documentation. It should include failure states: power loss, masking mute, fire alarm, HVAC setback, door held open, network maintenance and emergency operation.

Commissioning does not replace construction inspection or accreditation. It assembles operational evidence and confirms interactions.

Worked example 33.27. Mode coverage

A room has eight authorised and failure modes. Commissioning tests six. Coverage is 75 per cent, but the untested modes are after-hours HVAC setback and masking-controller failure, both relevant to quiet-state risk. The plan is incomplete.

33.28 Handover deliverables

Handover should transfer technical memory, not boxes of unsorted files. Deliverables include approved drawings, as-built models, submittals, test reports, calibration evidence, photographs, penetration and equipment registers, door and seal schedules, software configurations, credentials,

391 MB-1113. Office of the Director of National Intelligence, Technical Specifications for Construction and Management of SCIFs, Version 1.5.1.

maintenance instructions, training records, deficiencies, limitations and authority decisions.

The owner should receive both human-readable and durable machine-readable formats where appropriate. Proprietary software should not be the only means of accessing critical records. Checksums and manifests support integrity.

Controlled records are transferred through authorised channels. The handover index can acknowledge restricted documents without distributing them improperly.

Worked example 33.28. Handover manifest reconciliation

The contractor manifest lists 420 files. Automated checksum comparison finds 417 matching, two missing and one altered. Handover remains open until discrepancies are resolved and the corrected manifest is sealed.

33.29 Operations and maintenance requirements

Design must anticipate maintenance. Door seals require inspection and replacement. Masking systems require calibration and access control. Ducts, dampers and filters require service. Firestops can be disturbed. Electronics receive updates. A system that cannot be maintained without destroying evidence or isolation is poorly designed.

The specification should require maintenance access routes, removable covers, labelled components, spare parts, adjustment procedures and retest triggers. It should also prohibit unauthorised penetrations and define permit procedures.

Operations manuals should state which changes are routine, which require technical review and which require authority approval. Users need practical fault-reporting procedures.

Worked example 33.29. Seal replacement interval

A manufacturer recommends inspection every six months and replacement based on compression set and damage. The project's high cycle count suggests quarterly checks. The interval is justified by operating data rather than copied without context.

33.30 Change control after handover

Every change to the room's envelope, services, equipment, software, use or adjoining access should enter a documented impact review. The review identifies affected requirements, disciplines, evidence and authority. Minor work is not exempt simply because its cost is low.

The change record updates drawings, schedules, registers and baseline checksums. It also records whether retesting is required. A later reviewer can therefore distinguish authorised evolution from unexplained discrepancy.

Accumulated small changes should be reviewed periodically. Their combined effect can exceed that of one major project.

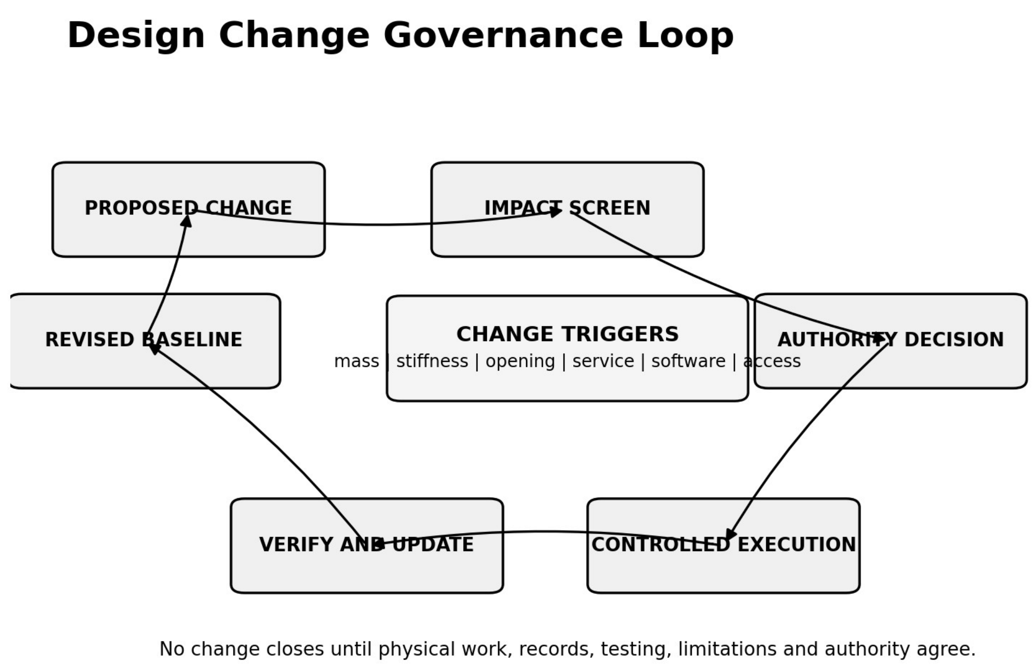

Figure 33-8. Design change control preserves the evidentiary chain. Author's original diagram.

Worked example 33.30. Change-impact score

A cable penetration scores 2 for acoustic effect, 3 for fire impact, 2 for TSCM and 1 for cyber, giving a screening total of 8. The project threshold for multidisciplinary review is 6. The score triggers review but does not determine the technical disposition.

33.31 Cost planning and value engineering

Secure-room cost planning should separate common building work, specialist systems, testing, surveillance, controlled access, commissioning and lifecycle obligations. Early budgets that price only wall area understate doors, services, documentation and testing.

Value engineering should compare function and residual risk, not delete invisible controls because they lack aesthetic value. Removing a sound lock, inspection hatch or mock-up can save initial cost while increasing failure and remediation risk. Proposals should include evidence, affected requirements, life-cycle cost and authority review.

Cost uncertainty should reflect incomplete design and controlled criteria. Contingency is not a substitute for closing requirements.

Worked example 33.31. Lifecycle value comparison

Option A costs 100 initially and 8 annually to maintain; option B costs 112 and 3 annually. Over ten undiscounted years, totals are 180 and 142. Option B is lower lifecycle cost if both satisfy the same authorised function. Discounting and risk would be included in a formal analysis.

33.32 Schedule control

Secure work has schedule drivers not present in ordinary fit-out: controlled reviews, specialist fabrication, escorts, hold points, mock-ups, laboratory reports, deficiency repair and authority decisions. These activities should appear in the critical path.

Schedule compression should not remove review or inspection. Where time is constrained, the project can use early-release packages, additional qualified reviewers, parallel mock-ups and staged acceptance. Starting repetitive construction before first-of-type closure merely transfers schedule risk into rework.

The schedule should identify information dependencies. A controlled criterion delivered late can affect procurement and construction.

Worked example 33.32. Critical-path effect

Door fabrication is 24 weeks, review 4 weeks and mock-up 3 weeks. If activities are sequential, duration is 31 weeks. Early review of a representative configuration can overlap 3 weeks of mock-up with fabrication preparation, but fabrication should not pass the approved release gate prematurely.

33.33 Quality planning

The quality plan describes how requirements will be verified through submittals, inspections, tests, audits and records. It identifies responsible persons, sampling, instruments, calibration, nonconformance, corrective action and record retention. Security restrictions are integrated into the plan.

Risk-based inspection focuses effort on high-leverage and concealed conditions while maintaining representative coverage. Sampling should account for clustered workmanship by crew, date, location and detail. Critical boundaries may require complete inspection.

Quality metrics should not reward documentation volume alone. Useful indicators include first-pass acceptance, repeat defects, closure time, unverified changes and retest rate.

Worked example 33.33. Stratified sample

A project has 300 ordinary penetrations, 60 high-risk penetrations and 20 movement joints. The plan samples 15 per cent of ordinary penetrations and 100 per cent of the other categories, producing 45 + 60 + 20 = 125 inspections. The rule is documented before selection.

33.34 Security of the procurement process

Bidders, manufacturers, laboratories and contractors may receive sensitive project information. The procurement plan should apply need-to-know access, controlled distribution, secure communications, device restrictions, visitor management, personnel checks where required and return or destruction of records.

Security controls should be proportionate. Excessive restriction can impair coordination and produce errors; insufficient control can expose vulnerabilities. Public drawings can omit controlled details while authorised teams receive complete information through secure channels.

Supply-chain review should identify counterfeit, substituted or undocumented components. Serial numbers, lot data and provenance are relevant for critical systems.

Worked example 33.34. Distribution reduction

A drawing package was initially distributed to 85 recipients. Role review finds only 42 require controlled details. The remaining recipients receive a coordination version. The change reduces exposure while preserving necessary work.

33.35 Laboratory and consultant procurement

Testing and specialist consultation should be procured with clear scope, competence and independence. The laboratory should be competent for the method and frequency range, with suitable facilities, calibration and reporting. Accreditation supports competence but does not replace review of scope.

The consultant’s role should include design review, mock-up, field observation, testing, diagnosis and reporting as needed. Independence is important where the same party designs, supplies and certifies a product. Conflicts should be disclosed and managed.

The contract should require raw data, processing settings, uncertainty, calibration certificates and limitations. Summary certificates alone are insufficient.

Worked example 33.35. Laboratory dynamic range

A required specimen is expected to provide 70 dB isolation in some bands, while the laboratory's demonstrated usable dynamic range is 62 dB. The laboratory can report only lower bounds unless receiving sensitivity is improved. Procurement selects a facility capable of the required evidence.

33.36 Design reviews

Design reviews should occur at defined maturity stages and involve relevant disciplines. Early review tests the threat and concept. Intermediate review tests interfaces and specifications. Final review tests completeness, constructability, inspectability, testability and source status.

Review comments receive stable identifiers and dispositions. Closing a comment means the documents have changed or the reviewer has accepted a reasoned response. It does not mean the comment was acknowledged.

Independent peer review can be valuable for high-consequence or novel systems. Its scope and access should be defined.

Worked example 33.36. Comment closure quality

A design review generates 160 comments. One hundred forty are closed by document change, 12 by accepted technical explanation and eight only by "noted". The last eight are not closed because no disposition is evident.

33.37 Constructability and testability reviews

Constructability asks whether the detail can be built with available access, tolerances, sequencing and trades. Testability asks whether the completed system can be measured and diagnosed. Both should occur before tender.

Examples include access to seal wall heads, space for duct silencers, ability to inspect firestops, clearance for door adjustment, source access to adjoining rooms and power for test equipment. A design that requires demolition to inspect routine work creates avoidable risk.

The review should include installers and commissioning personnel without allowing convenience to erase requirements.

Worked example 33.37. Access clearance

A detail leaves 40 mm between duct and structure, while the specified firestop installation requires 75 mm tool access. The clash is not a minor field issue; the design is revised before procurement.

33.38 Case study: performance-only wall failure

A project specifies a field rating but provides no prescriptive control of head, services or electrical boxes. The contractor selects a nominally strong partition but uses continuous backing, back-to-back boxes and a flexible head detail not represented in the laboratory report. Field testing fails in upper bands.

Investigation finds several paths. Repair requires opening completed finishes, relocating boxes and rebuilding the head. The failure was not caused by performance specification itself, but by treating the final number as a substitute for controlled mechanisms and inspection.

Worked example 33.38. Rework cost multiplier

The original incremental cost of detailed head control was 20 units. Post-finish remediation costs 85 units. The rework multiplier is 4.25. The calculation excludes schedule and security impact.

33.39 Case study: successful first-of-type release

A programme includes 30 similar secure rooms. Before repetitive work, one complete room is constructed with representative services, door, glazing and ceiling. Inspection reveals a service bracket bridging an isolated lining and a conflict between firestop depth and acoustic backing. Both are corrected and details updated.

The mock-up passes pretest and formal test. Installers receive training, and later rooms are audited against the frozen detail set. The process converts two early defects into programme-wide prevention.

Worked example 33.39. Avoided defect count

If each of the two mock-up defects would have occurred once in 30 rooms, correcting them before release avoids 60 defect instances. The estimate assumes repetition and is used only to illustrate preventive leverage.

33.40 Contractual hierarchy, order of precedence, and controlled criteria

A secure-room contract requires an explicit hierarchy because the same physical condition may be described in the owner’s requirements, the basis of design, drawings, technical specifications, schedules, approved submittals, authority instructions, code documents, and later clarifications; those records do not always use identical language or possess equal authority. A drawing may show a 25 mm cavity while a specification describes a tested assembly having a 38 mm cavity. A door schedule may identify one product family while an approved hardware set requires a frame preparation unavailable in that family. An acoustical note may call for a sealed wall head while the fire-resistive joint listing requires a defined movement space and tested mineral-fibre compression. The contract must say how conflicts are reported and resolved before fabrication, not after concealment.[392][393]

Order of precedence should not be used as a mechanical device for selecting the cheapest interpretation; a higher-ranking general requirement can define the protected result while a lower-ranking detail supplies the configuration needed to achieve it; the correct response to conflict is therefore reconciliation. The contractor identifies the exact inconsistency, affected requirement identifiers, physical consequence, proposed interpretation, schedule effect, and need for authority review; the design team then resolves the conflict through a controlled instrument that updates every dependent record. Silent field selection is a configuration change, even when the installer believes that one document plainly controls.

Controlled criteria create a further difficulty. The public contract may identify that an authority-controlled requirement exists without reproducing its value. The project should use controlled identifiers, need-to-know distribution, segregated schedules, and authorised reviewers so that the contractor receives enough information to build the work without unnecessary disclosure. A placeholder such as “meet security requirements” is inadequate because it neither allocates responsibility nor defines

392 MB-1106. Office of the Director of National Intelligence, Intelligence Community Directive 705, Sensitive Compartmented Information Facilities.
393 MB-1108. Office of the Director of National Intelligence, Intelligence Community Standard 705-1, Physical and Technical Security Standards for SCIFs.

evidence. Conversely, copying restricted thresholds into ordinary tender documents enlarges the information population without improving construction. The procurement plan should state who holds the criterion, how compliance is communicated, what submittals require controlled review, and what public-facing acceptance language may be used.[394][395]

The hierarchy must also preserve statutory and professional duties; neither a security criterion nor an acoustic target authorises departure from structure, fire, smoke, egress, accessibility, electrical safety, pressure control, moisture management, or heritage obligations; where requirements compete, the design team must produce a coordinated solution or elevate the unresolved issue to the competent authorities. The contract should prohibit one discipline from declaring another obligation waived by implication; a field report saying that a seal “improves acoustics” cannot approve an unlisted fire-joint alteration. A security reviewer cannot authorise an inaccessible threshold. An architect cannot convert a controlled authority decision into a decorative note without retaining its limitations.

Worked example 33.40. Conflicting cavity dimensions

A tested wall report identifies a 38 mm clear separation between independent stud rows; the architectural detail shows 25 mm because a column enclosure was tightened during coordination; the specification refers generally to the tested assembly; the contractor prices the 25 mm detail. Treating the drawing as automatically controlling would alter the mass-air-mass system and tested configuration. The project issues a controlled clarification, revises the column return, updates the wall schedule

394 MB-1238. U.S. Department of Defense, UFC 4-010-05.
395 MB-1223. U.S. Department of Defense, DoD Manual 5200.01 family, Information Security Program.

and model, and records the change against the requirement matrix before procurement release. The resolution is not a paperwork exercise. It restores one coherent physical configuration.

Table 33-2. Contractual hierarchy conflict record

Field	Required content	Release condition
Conflict identifier	Stable number and discovery date	Entered before affected work proceeds
Competing records	Exact document, revision, clause, detail and schedule references	All material sources identified
Physical consequence	Geometry, materials, interfaces, performance and safety effects	Reviewed by affected disciplines
Controlled criterion	Authority identifier and handling restriction	Reviewed through authorised channel
Resolution	Approved interpretation and revised records	Signed by assigned decision-makers
Downstream action	Submittal, procurement, fabrication, inspection and test changes	Closed in traceability matrix

33.41 Frequency-resolved performance schedules and quantitative requirement architecture

A secure-room performance schedule should retain the quantities needed to design and diagnose the room. Single-number ratings are useful for classification and communication, but they compress frequency-dependent behaviour and can conceal the band that governs speech exposure or structural transmission. Procurement documents should therefore distinguish the headline rating from the underlying spectrum, test method, source and receiver state, specimen or room geometry, background limit, and uncertainty. The schedule should state whether a value belongs to a laboratory element, an installed room pair, a doorset, a facade, a duct path, a vibration transfer function, or an occupied speech-security assessment.[396][397][398][399]

The requirement architecture should use metric-specific fields; a laboratory airborne sound-insulation requirement identifies the applicable method, specimen size, mounting, frequency range, reporting data, and permitted deviations; a field room-pair requirement identifies rooms, source positions, receiving positions, operating state, area or reverberation normalisation, rating method, background correction, and decision rule. A door requirement identifies leaf direction, seals, hardware, pressure, cycles, floor finish, and immediate surround; a closed-room speech requirement identifies source effort, language or signal, duration, listener access, background, masking, electronics, and the authority interpreting the result. These fields prevent one favourable number from migrating into a proposition it cannot support.

Frequency resolution also improves value engineering. A proposed substitution may preserve a nominal rating while changing low-frequency behaviour, coincidence region, perimeter leakage, or duct regeneration. The review should compare the band data relevant to the room's source spectrum and weak-path model. Where the source includes amplified conferencing, low-frequency plant, or structural excitation, a mid-frequency rating can be particularly misleading. The project may define protected

396 MB-1108. Office of the Director of National Intelligence, Intelligence Community Standard 705-1, Physical and Technical Security Standards for SCIFs.
397 MB-1109. Office of the Director of National Intelligence, Intelligence Community Standard 705-2, Standards for Accreditation and Reciprocal Use of SCIFs.
398 MB-1113. Office of the Director of National Intelligence, Technical Specifications for Construction and Management of SCIFs, Version 1.5.1.
399 MB-0252. ASTM International, ASTM E336-25a, ASTM E2638-24.

bands or minimum band values through controlled criteria, but public documents should not invent or infer them.

Quantitative schedules need units, reference conditions, tolerances, and significant figures; values such as “background 35” or “isolation 50” are incomplete; the record should identify dB weighting, time weighting, frequency band, reference pressure or acceleration, spatial statistic, operating mode, and whether the value is a target, maximum, minimum, nominal, or measured result. Tolerances should reflect both construction variability and measurement uncertainty; a specification that demands decimal precision beyond the method’s repeatability creates disputes rather than control.

Worked example 33.41. Rating preserved while a controlling band degrades

A specified wall has a laboratory rating of 60 and transmission loss of 49 dB at 125 Hz; a proposed assembly also rates 60 but provides 42 dB at 125 Hz; the room contains a wall-mounted conferencing loudspeaker with strong 125 Hz energy and a predicted receiving path controlled by that band. The substitution is not equivalent merely because the single-number ratings match; the review retains the spectrum, evaluates the composite room, and either rejects the proposal or requires a coordinated compensating design supported by evidence.

Table 33-3. Quantitative performance schedule fields

Quantity	Mandatory qualifiers	Evidence object
Laboratory element insulation	Method, specimen, mounting, frequency bands, rating and deviations	Complete accredited report
Field room-pair insulation	Rooms, state, positions, normalisation, background, uncertainty and rule	Approved test plan and field report

Quantity	Mandatory qualifiers	Evidence object
Door performance	Complete doorset, direction, pressure, seals, hardware, cycles and floor	Product report, installation record and field test
Duct or silencer performance	Airflow, pressure, insertion loss, regenerated noise, casing and installation	Laboratory report and system commissioning data
Structural vibration	Excitation, sensor, mounting, units, spectra, phase or coherence and state	Raw data, calibration and transfer analysis
Speech-security result	Source, listener, background, masking, signal, duration, method and authority	Controlled assessment and disposition

33.42 Interface matrices and three-dimensional coordination

Most secure-room procurement failures occur at interfaces rather than within uniform fields. A wall may be correctly specified yet fail where it meets a profiled deck, column, door frame, curtain wall, raised floor, isolated ceiling, duct, pipe, cable tray, or access panel. The procurement documents should therefore include an interface matrix that assigns each junction a stable identifier, governing mechanisms, participating trades, design owner, delegated-design boundary, submittal requirements, first-of-type representation, hold point, test or inspection, and lifecycle access requirement. A trade specification alone cannot reliably control work that belongs physically to several trades.

The matrix should be supported by three-dimensional coordination. A plan symbol can show that a conduit crosses a wall but may not show sleeve length, annular space, bend radius, firestop depth, acoustic backing, support location, maintenance access, or relationship to framing and resilient layers. A reflected ceiling plan can show a diffuser without the silencer, damper, flexible connection, hanger, casing breakout treatment, or plenum barrier. Critical interfaces should be represented in sections, isometrics, coordinated models, or fabrication drawings at a scale that makes ownership and sequencing visible.

Coordination should include movement. Structures deflect, walls shorten, pipes expand, ducts vibrate, doors sag, glazing frames move, and seismic restraints engage. A static drawing can become a rigid bridge if it ignores relative displacement. The interface record should state expected movement, clearances, flexible elements, restraint conditions, fire-joint requirements, and inspection method. The specification should identify which dimensions are minimum clearances, which are nominal construction dimensions, and which are protected ranges that may not be consumed by finish tolerances.

Access is another design variable. An acoustically strong silencer connection that cannot be inspected, cleaned, or replaced may deteriorate silently; a sealed service chase with no controlled access can encourage later drilling through the protected boundary; procurement should value observable, maintainable interfaces. Access panels, removable barriers, spare sleeves, service zones, and replacement routes should be designed so that maintenance does not require improvisation; the room data sheet should identify each lifecycle access point and the change-control process governing it.

Worked example 33.42. Cable tray crossing owned by no trade

The electrical drawings show a tray crossing a protected wall; the architectural detail shows a generic firestop; the acoustic specification requires isolated leaves and no rigid bridge; the firestop contractor expects the tray contractor to provide a sleeve, while the tray contractor expects direct passage through the opening. The interface matrix assigns the opening to a coordinated penetration detail, identifies the sleeve and support arrangement, separates supports on each side, defines fire and acoustic closure, requires a first-of-type mock-up, and establishes a pre-closure hold point. The matrix converts an organisational gap into buildable work.

Table 33-4. Interface matrix minimum fields

Interface	Design owner	Participating trades	Evidence and release
Wall to structure	Architect and structural engineer	Framing, firestop, finishes	Movement detail, listing, mock-up and hold point
Door frame to wall	Architect or door specialist	Framing, masonry, hardware, security	Rough-opening survey, anchors, seal geometry and functional test
Duct through boundary	Mechanical engineer	Duct, silencer, controls, fire and acoustic trades	Coordinated section, airflow data, casing treatment and commissioning
Pipe or sprinkler crossing	Mechanical or fire-protection engineer	Pipe, support, seismic, firestop and acoustic trades	Sleeve, flexible geometry, support record and operational test
Cable pathway	Electrical or ICT engineer	Tray, conduit, firestop, security and acoustic trades	Penetration ID, support separation, seal and change register
Raised floor or ceiling boundary	Architect and services engineers	Floor, ceiling, partitions and all services	Full perimeter detail, first-of-type and concealed-work release

33.43 Evidence sufficiency and forensic review of laboratory reports

Submittal review should test evidence sufficiency rather than count documents. A thick package can remain inadequate when it contains brochures, cropped certificates, expired listings, unrelated laboratory reports, or drawings that do not match the proposed work. The reviewer should identify the proposition to be supported, then determine whether the evidence describes the same product, configuration, dimensions, materials, mounting, boundary, hardware, seals, service state, and method.

Evidence that supports only one component should not be enlarged into proof of a complete room.[400][401][402][403]

A laboratory report requires forensic reading. The cover page and headline rating are not enough. The reviewer should examine the laboratory identity and accreditation scope, test date, method edition, specimen drawings, dimensions, leaf masses, framing, fasteners, cavities, absorbers, perimeter seals, mounting frame, curing, environmental conditions, microphone and source procedures, background, dynamic range, frequency data, deviations, uncertainty where reported, and signatures. Photographs should be compared with drawings. The report should be complete enough that a technically competent reviewer can reconstruct the specimen and identify differences from the project proposal.

Report provenance matters. A PDF received from a distributor may have been renamed, excerpted, or separated from appendices. The submittal should identify the original file, source, report number, issue date, revision, and cryptographic digest where proportionate. The reviewer should verify the document with the issuing laboratory or manufacturer when authenticity or completeness is material. A digest proves byte equality to a known file, not that the specimen was built as claimed or that the report applies to the project.

The review should distinguish direct evidence from analogy; a report on a 900 mm by 2100 mm single door cannot automatically support a larger

400 MB-1109. Office of the Director of National Intelligence, Intelligence Community Standard 705-2, Standards for Accreditation and Reciprocal Use of SCIFs.
401 MB-1113. Office of the Director of National Intelligence, Technical Specifications for Construction and Management of SCIFs, Version 1.5.1.
402 MB-1043. National Institute of Building Sciences, Whole Building Design Guide public secure-facility and commissioning resources.
403 MB-0880. International Organization for Standardization, ISO 19650.

paired doorset with different frame, seals, hardware, threshold, glazing, or pressure; a wall test with no outlets does not prove a field wall containing back boxes and service zones. Analogy may support engineering judgement, but the judgement must identify differences, physical consequences, uncertainty, and authority; where equivalence remains uncertain, the remedy is project-specific testing, a first-of-type assembly, conservative redesign, or rejection.

Worked example 33.43. Missing appendix changes the conclusion

A door submittal includes a certificate stating a rating of 52; the complete laboratory report, obtained after review, shows that the tested leaf had no vision panel, used a fixed threshold, and was evaluated without the project's access-control hardware. The proposed doorset includes a 0.3 square metre vision panel, an automatic bottom, electrified mortise hardware, and a different frame; the certificate is genuine but insufficient; the reviewer records the configuration differences, requires complete evidence or a project-specific test, and prevents fabrication until the gap is resolved.

33.44 Procurement of doorsets, glazing, silencers, and service interfaces

Certain systems deserve package-level procurement because their performance depends on components supplied by several firms; doorsets include leaf, frame, anchors, hinges, latch, closer, seals, automatic bottom, threshold, glazing, access-control hardware, power transfer, finish, and surrounding construction; glazing includes panes, laminates, cavities, frames, gaskets, setting blocks, mullions, anchors, perimeter seals, fire or impact obligations, and replacement method. Silencers include acoustic media, casing, transitions, airflow direction, pressure loss, regenerated noise, access, supports, flexible connections, dampers, and breakout control; service penetrations include the opening, sleeve, penetrating item, supports, firestop, smoke seal, acoustic closure, identification, inspection, and future change route.

Procurement should assign one party responsibility for package integration even when components come from several suppliers; fragmented buying can produce individually compliant parts that do not assemble into a compliant system; a door manufacturer may provide a rated leaf while the frame supplier provides a different profile and the hardware contractor cuts unreviewed preparations. A silencer may meet insertion-loss data but be installed backwards, short-circuited by a bypass, or connected to a thin duct casing that radiates around it; package-level submittals and shop drawings reveal these conflicts before delivery.

The contract should define factory and site responsibilities; factory preparation can improve consistency but may limit later adjustment; site modification can solve geometry but may invalidate labels or evidence; the permitted field operations should be listed. Unauthorised drilling, trimming, welding, cutting, glazing replacement, hardware changes, or seal substitutions should be treated as nonconformances until reviewed. Spare parts and replacement sources should be procured or identified at handover because a room can lose validity years later when obsolete seals or controllers are replaced by convenient alternatives.

Logistics also affect technical performance. Large doors and silencers require storage, handling, environmental protection, lifting, route planning, and inspection on receipt; glazing edges and laminates can be damaged before installation; seal materials can age or deform in poor storage; acoustic media can become wet or contaminated. The procurement schedule should include factory release, shipping restraints, receiving inspection, quarantine of damaged items, environmental limits, and traceability to the installed location.

Worked example 33.44. Silencer data without system responsibility

A silencer is selected from laboratory insertion-loss data; the mechanical contractor purchases the silencer, a sheet-metal subcontractor fabricates transitions, and a controls subcontractor adds a damper immediately upstream; no party evaluates combined pressure drop, regenerated noise, casing breakout, support vibration, or maintenance access. Package-level review identifies the conflict, relocates the damper, stiffens and treats the transition, adds separated supports, and defines airflow and acoustic commissioning; the product data remain useful, but the installed path becomes the procurement object.

33.45 Commercial evaluation, alternates, allowances, contingencies, and value engineering

Commercial evaluation should preserve technical comparability. Bids often appear different because firms interpret scope, evidence, testing, mock-ups, security, access, overtime, logistics, and risk differently. A bid-normalisation schedule should identify exclusions, assumptions, alternates, provisional sums, allowances, unit rates, testing, rework, record production, training, spares, and lifecycle services. The lowest initial price may be based on omitted evidence or transferred risk rather than efficient delivery.

Alternates should be structured as controlled design options, not invitations to delete mechanisms; each alternate should identify the affected requirements, configuration, expected performance, evidence, uncertainty, fire and structural implications, room-area effect, schedule, maintenance, testing, and authority review. A price reduction for eliminating a sound lock is not meaningful without recalculating door exposure, operations, access control, and receiving background; a lighter wall may save structure but alter low-frequency response and workmanship sensitivity; value engineering should compare whole-room and lifecycle consequences.

Allowances require boundaries. An allowance for “acoustic treatment” without quantity, scope, performance, and evidence encourages late selection of decorative absorption unrelated to sound isolation. A testing allowance should identify methods, rooms, states, repeats, diagnostics, witnesses, reports, and failure response. A controlled-criteria allowance should identify who may direct the work and how the price will be established without disclosing unnecessary information. Unit rates should be provided for foreseeable change items such as additional sleeves, door seals, local opening tests, overnight access, or retesting.

Contingency should follow uncertainty. Existing buildings, historic fabric, concealed construction, landlord-controlled services, and overseas logistics carry greater configuration uncertainty than new repetitive work. The project should maintain a technical contingency register linking each uncertainty to investigation, decision date, budget, schedule float, and fallback. A general monetary contingency does not close a design question, but it prevents the team from pretending that unknown conditions have no commercial consequence.

Worked example 33.45. Low bid omits the evidence chain

Bid A is 8 per cent lower than Bid B; normalisation shows that Bid A excludes first-of-type mock-ups, pre-closure inspection support, independent laboratory testing, raw-data delivery, door commissioning, security escorts, and correction of failed work; when those obligations are priced consistently, Bid A becomes 6 per cent higher and carries greater schedule risk. The comparison does not guarantee Bid B's competence; it reveals that the original price ranking was based on unlike scopes.

33.46 First-article release, production sampling, and defect-population control

A first-of-type mock-up is useful only when it represents the controlling interfaces; a perfect wall panel without a head joint, corner, door, conduit, duct, firestop, ceiling, or floor tells little about the repeated room; the procurement documents should define the first article by physical features, sequence, participating trades, products, tolerances, inspection points, tests, and release criteria. It may be a freestanding mock-up, the first production room, or a series of interface samples; the selected form should expose the mechanisms most likely to fail.

Release should be conditional on evidence. The first article is inspected while concealed work remains visible, functionally operated, measured where appropriate, and reconciled with approved submittals; defects are not merely repaired in the sample; their causes are traced into drawings, methods, training, tools, material control, supervision, and inspection. Repetitive work should not begin until the corrective action is embedded in the production process; a sample that is hand-built by specialists under extraordinary supervision may not demonstrate ordinary production capability.

Production sampling should follow risk and population structure; interfaces with high consequence, poor detectability, or strong workmanship dependence may require full inspection; repetitive low-risk features may use stratified or random sampling after first-article release; sampling units should correspond to causal populations such as crew, shift, floor, material batch, door model, detail family, or installation period. A convenient sample of five rooms can miss a defect confined to one subcontractor or one delivery lot.

When a defect is found, the project should bound the affected population; the inquiry asks when the condition began, which crews and materials were involved, what inspections occurred, and what records can exclude unaffected work; the response may expand inspection, open concealed work, suspend production, quarantine material, or impose temporary operational limits. Statistical language should not disguise engineering judgement; a low observed defect rate in a biased sample does not prove a low population rate.

Worked example 33.46. First article passes but production drifts

The first doorset is installed by the manufacturer’s specialist and passes functional and local acoustic checks; production doors are installed by three site crews; trend review after eight doors shows that one crew consistently leaves lower latch-jamb compression. The population is stratified by crew, the affected doors are reinspected, installation tools and instructions are corrected, and later sampling is intensified for that crew; the project does not invalidate the first article. It recognises that production capability changed.

33.47 Common data environment, cybersecurity, provenance, and controlled distribution

The common data environment is part of technical security because the accepted room exists partly as information. Requirements, drawings, models, photographs, test data, software configurations, authority decisions, and change records must remain identifiable and recoverable. The environment should support stable identifiers, revision control, status codes, permissions, audit logs, retention, backup, export, and checksum verification. It should also distinguish working information from shared, published, archived, superseded, and controlled records.[404][405]

Cybersecurity and project security should be integrated rather than assumed; a cloud platform may provide strong general controls while placing data in an unauthorised jurisdiction, enabling uncontrolled external sharing, or retaining deleted versions beyond the project's handling rules. Mobile devices may synchronise photographs to personal accounts; model viewers may expose hidden layers or metadata; automated notifications may disclose room names and project roles. The information-management plan should identify approved systems, identities, authentication, device configuration, encryption, export controls, external collaborators, incident response, and offboarding.

404 MB-1109. Office of the Director of National Intelligence, Intelligence Community Standard 705-2, Standards for Accreditation and Reciprocal Use of SCIFs.
405 MB-1113. Office of the Director of National Intelligence, Technical Specifications for Construction and Management of SCIFs, Version 1.5.1.

Provenance should survive format conversion. A PDF drawing derived from a model should record the source model, revision, issue status, author, approval, date, and digest. A processed acoustic spectrum should link to raw data, instrument configuration, calibration, script or software version, parameters, operator, and output digest. A photograph should link to location, orientation, time, observer, inspection unit, and custody. Durable derivatives can supplement proprietary files, but they should not silently replace the native record.

Automated checks can improve control. Scripts can detect missing identifiers, duplicate filenames, obsolete revisions, unresolved comments, altered hashes, absent metadata, or cross-reference conflicts; automation should produce a reviewable report and should not be treated as authority; a checksum can show that a file changed but not whether the change was authorised or correct. An access log can show that an account opened a file but not who sat at the keyboard; technical conclusions remain bounded to the evidence.

Worked example 33.47. Correct drawing, wrong issue status

A contractor downloads a technically correct wall detail from the common data environment, but the file remains marked “shared for coordination” rather than “published for construction”. A later published version adds a fire-joint movement requirement. The workface used the wrong status, not necessarily the wrong filename. The information plan is revised to separate published folders, require mobile acknowledgement of superseded drawings, and log the issue status used at each hold point.

33.48 Dispute prevention, expert evidence, and preservation duties

Procurement documents should be written so that later disagreement can be resolved from evidence. Ambiguous adjectives, undocumented telephone instructions, incomplete submittal dispositions, hidden deviations, and test criteria invented after completion create disputes because the parties cannot reconstruct the bargain or the installed state. A strong record identifies requirement, authority, configuration, observation, method, result, uncertainty, decision, and change. This structure supports both project management and expert analysis without turning ordinary administration into adversarial theatre.

Potential disputes should trigger preservation proportionate to consequence. Relevant drawings, submittals, correspondence, photographs, samples, hardware, test data, instrument records, software, models, access logs, and change records may need to be retained. Destructive testing should be planned with notice, documentation, custody, and restoration where legal duties or anticipated litigation require it. The project team should involve counsel and competent investigators when privilege, spoliation, personal data, classified information, export controls, or criminal allegations arise. The technical specification cannot determine every legal duty, but it can require disciplined records and escalation.[406][407]

Expert review should distinguish contract interpretation from physical causation. A wall can fail a contractual criterion because it was built differently from the approved assembly, because the approved design was insufficient, because a field method was misapplied, because background

406 MB-0880. International Organization for Standardization, ISO 19650.
407 MB-1252. U.S. Department of Defense, UFGS quality control, special inspection.

limited the result, or because a separate path controlled. These explanations have different responsibility and remedy. The expert should state facts supplied by others, observations, calculations, assumptions, alternative hypotheses, uncertainty, and opinions. A polished report is not reliable merely because it reaches a decisive conclusion.

Dispute prevention also requires contemporaneous resolution. Open requests for information, unreviewed substitutions, missed hold points, and conditional acceptances should not be allowed to accumulate until final testing. A technical issue register should show age, criticality, affected work, temporary controls, owner, required evidence, and closure authority. The project may proceed around an issue only when the boundary of permitted work is explicit.

Worked example 33.48. Failed test and premature attribution

A completed room misses a field criterion by 4 dB; the contractor blames the door supplier, while the designer blames workmanship; review finds that background correction is valid, the door perimeter is locally weak, and a shared return path contributes comparable energy. The approved design also omitted a maintenance damper position used during the test; the causal record assigns separate findings to design state, installation, and operating configuration. Remediation addresses both dominant paths, and responsibility is evaluated against the contract rather than one convenient suspect.

33.49 Multijurisdictional procurement and authority overlays

A multinational project should separate the common engineering core from jurisdiction-specific authority. The common core includes source-state definition, path analysis, construction continuity, product evidence, field measurement, uncertainty, commissioning, configuration control, and lifecycle assurance. The overlay identifies governmental or institutional terminology, responsible officials, controlled documents, accreditation or approval process, procurement restrictions, security clearances, document handling, witnesses, reciprocity, and continuing-use rules. Similar room labels should not be translated as though they were equivalent legal categories.[408][409]

The contract should identify the governing location and authority for each facility. A corporate standard may set a global minimum, but local building, fire, accessibility, labour, privacy, procurement, and professional-licensing law still applies. Governmental work may require approved products, cleared firms, secure transport, restricted records, national technical authorities, or designated acceptance officials. The design team should produce a gap matrix rather than blend all requirements into one anonymous “international standard”.

Standards editions also differ by jurisdiction and contract date; a public ISO or ASTM method may be widely used while a government authority requires another edition, supplementary procedure, or controlled criterion; the source register should state issuer, exact title, number, edition, status, jurisdiction, public locator, project use, and limitation. Where a source has been superseded after contract award, the project should determine whether the contract, code, authority, or change process requires migration;

408 MB-1106. Office of the Director of National Intelligence, Intelligence Community Directive 705, Sensitive Compartmented Information Facilities.
409 MB-1108. Office of the Director of National Intelligence, Intelligence Community Standard 705-1, Physical and Technical Security Standards for SCIFs.

calling every newly published document automatically controlling can be as erroneous as relying on an obsolete edition.

Cross-border information transfer deserves specific control. Drawings, photographs, test data, and room identifiers may be restricted by government policy, client rules, privacy law, export control, or contract. The procurement strategy should minimise disclosure, use controlled identifiers, segregate public and restricted packages, and ensure that offshore fabrication or review receives only authorised information. Restriction should not be used to avoid technical clarity. The responsible supplier still needs a complete, buildable requirement within its authorised scope.

Worked example 33.49. Common design, different acceptance routes

One organisation procures similar protected meeting rooms in the United States, United Kingdom, and Canada. The wall, door, HVAC, measurement, and configuration-control principles are harmonised. The authority matrix remains separate. Each site uses its own responsible officials, controlled criteria, document markings, witness requirements, and continuing-use decisions. A favourable field result in one country informs engineering but does not confer approval in another.

33.50 Integrated procurement case study: legal and diplomatic conference suite

A mixed-use headquarters contains a legal conference suite on one floor and a diplomatic liaison room on another; the owner initially proposes one standard “high privacy” package. Requirement development shows material differences. The legal suite supports privileged commercial discussion, remote conferencing, ordinary and raised speech, and landlord-controlled adjoining spaces; the diplomatic room supports authority-defined protected discussion, restricted records, cleared access, controlled communications, and a formal use decision; the project adopts a common engineering platform but separate authority overlays.

The common platform uses double-leaf partitions, full-height continuity, package-procured doorsets, controlled glazing, duct silencers, registered services, masking, approved audiovisual states, first-of-type interfaces, construction surveillance, field room-pair testing, closed-room speech assessment, and lifecycle change control. Room data sheets distinguish source levels, conferencing gain, listener positions, quiet states, after-hours access, HVAC modes, cleaning, maintenance, and emergency operation. The traceability matrix links each requirement to design, submittal, inspection, test, and authority.

Procurement is divided into coordinated work packages; the envelope package owns walls, ceilings, floors, glazing, and interfaces; the doorset package owns complete doors, frames, hardware, seals, access-control preparations, commissioning, and spares; the mechanical package owns branch routing, silencers, casing, supports, airflow, pressure, controls, and maintenance access. The technology package owns microphones, loudspeakers, conferencing, controls, firmware, gain limits, network state, and configuration export. A project integration schedule identifies every cross-package junction.

During submittal review, the proposed legal-suite door has complete laboratory evidence but the diplomatic-room door adds electrified hardware and a larger vision panel; the project refuses to transfer the rating without analysis; a first-of-type doorset is built with final hardware, seals, floor finish, wall return, pressure condition, and access control. It is inspected, cycled, adjusted, and measured; the resulting configuration becomes the production baseline. The diplomatic criterion remains controlled, while the public record states only that the authorised reviewer accepted the evidence for the defined use.

Construction surveillance discovers two issues. A cable tray support crosses independent framing at one service zone, and a ceiling contractor fills a movement joint rigidly. Both defects are corrected before closure. The causal review changes the support detail, adds a visual bridge check to the hold point, revises training, and expands sampling to similar locations. The project does not merely repair the two observations. It prevents propagation.

Commissioning proceeds from construction release to functional operation, path diagnostics, room-pair measurement, speech assessment, authority disposition, and baseline issue. The legal suite passes its defined criteria after conferencing gain is limited and a corridor masking zone is balanced. The diplomatic room receives a conditional authority disposition pending replacement of one controller component, with an operational restriction and expiry date. The final dossier distinguishes the technical results from the use decision.

Worked example 33.50. Whole-room effect of two procurement changes

Before correction, predicted receiving contributions in a critical band are door 33 dB, duct 31 dB, wall 24 dB, and ceiling flank 26 dB; their energetic total is approximately 35.5 dB; package review improves the door contribution by 7 dB to 26 dB and the duct by 6 dB to 25 dB. The new total is approximately 30.0 dB; the nominal local improvements do not add arithmetically because wall and ceiling paths become more important. The procurement case demonstrates why package decisions must be evaluated through the complete path budget.

33.51 Long-lead procurement, obsolescence, spare parts, and maintainability

A protected room can be technically correct at handover and operationally fragile one year later because a seal, controller, hinge, calibrator, silencer access component, or proprietary configuration tool is no longer available. Procurement should therefore test maintainability at the same time that it tests initial compliance. The review should identify design life, expected duty cycle, environmental exposure, replaceable parts, proprietary dependencies, lead times, storage limits, firmware support, calibration support, compatible substitutes, authorised repair routes, and the evidence required after replacement. A product whose headline performance is excellent but whose critical consumables cannot be procured through the expected service life may impose a larger security and continuity risk than a slightly less ambitious system with observable wear, stocked spares, and reproducible adjustment.[410][411][412][413]

Long-lead items require a controlled release sequence; acoustic doorsets, specialist glazing, silencers, vibration isolators, custom control panels, and laboratory instrumentation may enter fabrication before every architectural

410 MB-1223. U.S. Department of Defense, DoD Manual 5200.01 family, Information Security Program.
411 MB-1023. National Counterintelligence and Security Center, Public technical-security and counterintelligence resources.
412 MB-1113. Office of the Director of National Intelligence, Technical Specifications for Construction and Management of SCIFs, Version 1.5.1.
413 MB-1043. National Institute of Building Sciences, Whole Building Design Guide public secure-facility and commissioning resources.

finish or control interface is final; early release is defensible only when the frozen attributes and remaining interfaces are explicit. The release record should distinguish dimensions that are irrevocable, such as rough opening, frame depth, hinge preparation, glazing rebate, silencer casing, and connector location, from attributes that remain adjustable, such as finish, selected hardware function, control programming, and final set point. An early-release package should include assumptions, hold points, change authority, interface drawings, and the commercial consequences of later change; it should not use urgency to transfer unresolved design risk silently to the manufacturer.

Obsolescence control is particularly important for software-dependent systems. A masking controller, conferencing processor, access-control interface, or networked monitoring device can remain physically intact while its operating system, security certificate, vendor cloud service, or configuration application becomes unsupported. The procurement record should identify offline administration capability, exportable configuration, firmware baseline, credential custody, audit logs, restoration procedure, licence conditions, and the consequences of vendor failure. A checksum of a configuration file supports byte-level comparison. It does not prove that the file contains every material state or that the device loaded it successfully. Functional verification remains necessary after restoration or replacement.[414][415][416][417]

Spare-parts planning should be risk based. Ordinary consumables can be purchased through routine maintenance, while unique seals, automatic

414 MB-1252. U.S. Department of Defense, UFGS quality control, special inspection.
415 MB-0239. ASTM International, ASTM E2713-25, ASTM E3176-24.
416 MB-0252. ASTM International, ASTM E336-25a, ASTM E2638-24.
417 MB-0880. International Organization for Standardization, ISO 19650.

door bottoms, electronic hinges, controller modules, specialised microphone capsules, or matched glazing gaskets may deserve project stock; stored items require environmental control, shelf-life tracking, identity, and inspection. A spare that has hardened, corroded, lost calibration, or become incompatible with current firmware is not a reliable spare; the owner should also preserve adjustment tools, templates, test adapters, passwords, keys, and authorised instructions; technical memory often resides in these apparently minor objects.

Maintainability should be tested in the mock-up. The team should demonstrate replacement of a representative door seal, access to a silencer inspection point, removal and restoration of a ceiling panel, addition of a cable through the authorised pathway, export and restoration of a software baseline, and reinspection of the affected boundary. The exercise can reveal inaccessible fasteners, destructive finish details, inadequate service loops, missing isolation clearances, or a repair sequence that defeats fire or acoustic construction. Procurement should value the ability to restore the verified mechanism, not merely the ability to install it once.

Worked example 33.51. Spare-parts decision under lead-time risk

A doorset uses a proprietary automatic bottom with an expected replacement interval of five years; procurement lead time is thirty-two weeks, the room cannot remain in protected use with the bottom failed, and the project has twelve identical doors. A simple expected-demand screen assumes a ten-year horizon and one replacement per door; the programme stocks four complete units and a compatible seal kit, while retaining a framework order for additional units; the quantity is not a reliability prediction. It is a continuity decision based on consequence, lead time, commonality, storage life, and the ability to inspect stored stock.

Table 33-5. Maintainability and obsolescence review

Subject	Required procurement evidence	Release question	Lifecycle trigger
Replaceable seals and hardware	Part numbers, adjustment range, cycle data, spares and instructions	Can the verified contact geometry be restored?	Wear, damage, floor change or pressure change
Silencers and service components	Access, cleaning, pressure loss, replacement and identity	Can inspection occur without dismantling the boundary?	Fouling, airflow change, damage or plant alteration
Software-controlled systems	Firmware, configuration export, credentials, logs and offline recovery	Can the accepted state be recovered without vendor guesswork?	Update, certificate expiry, hardware replacement or service withdrawal
Instrumentation and calibrators	Calibration support, adapters, environmental limits and service route	Can traceability be maintained over the programme life?	Calibration expiry, repair, drift or method change
Stored spares	Shelf life, storage conditions, identity and inspection	Will the spare remain usable when required?	Expiry, packaging damage, incompatibility or stock withdrawal

33.52 Independent technical review, witness architecture, and reviewer competence

Review should be designed as an evidentiary control rather than treated as a ceremonial signature. A reviewer can examine calculations, drawings, specifications, source status, interfaces, measurement plans, uncertainty, and report language, but the review has value only when scope, competence, independence, access, and disposition are defined. The project should identify which questions require designer self-check, interdisciplinary coordination, independent technical review, laboratory quality review, owner review, security-authority review, code review, or legal review. These functions may overlap, yet they are not interchangeable.[418][419][420][421]

Competence should correspond to the proposition. A structural engineer may verify support capacity and movement; a fire-protection professional may verify listing compatibility and inspection requirements; a door specialist may verify frame, hardware, clearances, closing force, and maintenance; an acoustical engineer may verify transmission mechanisms, test methods, and uncertainty. A laboratory may verify its measured quantity. A security authority may decide authorised use. No reviewer should be represented as approving matters outside the reviewer's scope merely because the signature appears on a common form.

Independent review is strongest when it can reproduce the reasoning; the package should include source files, equations, variables, units, assumptions, intermediate results, software versions, model geometry, input data, rejected options, and sensitivity analysis; a PDF image of a spreadsheet total is not enough. Where proprietary software is used, the reviewer should receive the model file or a complete export sufficient to rebuild the calculation; where controlled information cannot be distributed, the review plan should provide authorised access, redacted interfaces, or an in-place examination without weakening the technical question.

Witness architecture should distinguish hold points, witness points, surveillance, and record review; a hold point prohibits progress until release;

418 MB-0855. International Organization for Standardization, ISO 12999-1:2020.
419 MB-0983. JCGM 100:2008, JCGM 106:2012.
420 MB-1108. Office of the Director of National Intelligence, Intelligence Community Standard 705-1, Physical and Technical Security Standards for SCIFs.
421 MB-1113. Office of the Director of National Intelligence, Technical Specifications for Construction and Management of SCIFs, Version 1.5.1.

a witness point gives notice and permits progress under defined conditions if the witness does not attend; surveillance observes selected work without assuming continuous presence. Record review examines evidence after the event and cannot recreate a missed concealed condition. The project should choose the control that matches consequence and observability. Labelling every activity a hold point overwhelms the programme and encourages informal bypass, while labelling every concealed interface a record review can leave decisive conditions unobserved.

Review comments need closure logic. Each comment should identify the affected requirement, evidence, severity, responsible party, required response, disposition, and verifier; a response such as “noted” is not closure when the comment concerns a physical contradiction; the reviewer should record whether the response resolves, qualifies, rejects, or supersedes the issue. Repeated comments on the same mechanism can reveal a systemic defect in the design process, specification, supplier instruction, or reviewer workload; comment statistics should therefore support process improvement, not simply measure speed.

Independence should be proportionate. A manufacturer can provide indispensable product expertise but should not be the only judge of system equivalence; a contractor can perform quality control but should not unilaterally accept its own deviation; a laboratory can report test results but should not declare governmental accreditation. In lower-consequence work, one competent person may perform several roles, provided the record discloses them and no prohibited conflict exists; in higher-consequence work, separate review, witnessing, and authority decisions provide stronger defence against common assumptions and commercial pressure.

Worked example 33.52. Review depth selected by consequence

A standard office privacy partition receives designer check and contractor submittal review; a privileged legal meeting room adds independent acoustical review, first-of-type witnessing, and owner acceptance; a government-controlled protected room adds the responsible authority's controlled review and use decision. The wall physics may be similar, but the evidence, independence, document handling, and decision architecture differ; the project does not call these three processes equivalent.

Table 33-6. Review and witness responsibility matrix

Review object	Primary technical reviewer	Independent or authority review	Prohibited inference
Structural support and movement	Structural engineer	Engineer of record or delegated-design checker	Structural acceptance proves acoustic performance
Firestop and fire-resistive joints	Fire-protection professional	Code or project authority	Fire listing proves sound isolation
Doorset package	Door, hardware, access, and acoustical reviewers	Project release authority	Product rating proves installed room result
Field acoustic test	Competent test team or laboratory	Independent technical checker and accepting authority	Laboratory competence accredits the room
Speech-security proposition	Qualified specialist	Responsible security or privacy authority	One test establishes every listener and operating state
Controlled project criterion	Authorised project team	Competent governmental or institutional authority	Public similarity discloses or replaces the criterion

33.53 Portfolio analytics, lessons learned, and common-cause procurement governance

A single room is procured as a project, but a portfolio should be governed as a population. Repeated rooms create the opportunity to learn from doorset drift, seal life, fastener errors, silencer substitutions, software updates, contractor crews, inspection methods, and maintenance practices. They also create the risk that one defective detail, ambiguous instruction, counterfeit component, or unsupported software version will propagate widely before a complaint appears. Procurement should therefore preserve identifiers and causal data that allow the owner to recognise an affected population.[422][423][424][425]

The data model should connect requirement, room, assembly, product, lot, serial number, supplier, contractor, crew, installation date, reviewer, test result, nonconformance, repair, maintenance event, software version, and authority disposition. Not every project needs a complex database. Every programme does need stable identifiers and relationships that permit questions such as: Which rooms contain the same door bottom? Which silencers came from the affected batch? Which rooms were built from the superseded detail? Which tests used the same calibrator after an adverse drift finding? Which controllers received the same firmware update? Without those links, a common-cause finding becomes a manual search through boxes and email.

Analytics should avoid naive ranking. A contractor with more findings may simply have performed more work or received more intensive inspection; an older product family may show more maintenance events because it has longer exposure; a higher-performing room may have received more frequent tests. Useful analysis therefore normalises by population, exposure, service years, inspection intensity, room consequence, and opportunity for detection; severity and mechanism matter more than raw

422 MB-1043. National Institute of Building Sciences, Whole Building Design Guide public secure-facility and commissioning resources.
423 MB-0239. ASTM International, ASTM E2713-25, ASTM E3176-24.
424 MB-1106. Office of the Director of National Intelligence, Intelligence Community Directive 705, Sensitive Compartmented Information Facilities.
425 MB-1223. U.S. Department of Defense, DoD Manual 5200.01 family, Information Security Program.

count. One concealed rigid bridge repeated across twenty rooms can deserve more urgent action than many minor documentation corrections.

Lessons learned should change a control. A narrative report stored after closeout is easily forgotten. The closure record should identify the affected requirements, drawings, specifications, submittal checklist, training, sampling plan, spare-parts policy, maintenance instruction, software baseline, and existing-room population. It should name an owner, implementation date, verification method, and review date. A lesson is not institutionalised until a later project can demonstrate the changed control.

Common-cause review should proceed in both directions; a new failure can be traced backwards to rooms with the same condition; a successful room can be traced forwards to identify details and processes worth standardising. Positive evidence is important. It can show that a doorset remains stable after heavy cycling, that a reversible historic lining is maintainable, that a first-of-type hold point prevents recurrent cable bridges, or that a software change process preserves gain limits; procurement standards should be informed by demonstrated stability, not only by failures.

Portfolio governance also supports supplier management. The owner can evaluate first-pass acceptance, repeat defects, response time, evidence completeness, corrective-action quality, calibration integrity, configuration recovery, and lifecycle support. These indicators should be discussed with context and should not become simplistic scorecards that incentivise concealment. A supplier that reports and corrects a defect competently may be more reliable than one that reports no defects because inspection and records are weak.

Worked example 33.53. Affected-population search

Three rooms exhibit overlong screws that bridge resilient channels; all three were completed during the same two-week period by one crew using a substitute screw carton; the programme identifies eleven additional rooms with the same crew, date range, detail, and lot. Targeted inspection finds four more bridges. The common-cause review changes material control, screw-length gauges, first-layer hold points, and training; the response is based on causal identifiers rather than a random portfolio sample.

33.54 Legal privilege, disclosure control, claims avoidance, and expert-report readiness

Protected-room projects can generate records that are technically valuable, commercially sensitive, security restricted, legally privileged, personally identifiable, or potentially discoverable in a dispute; procurement should establish information classes before records accumulate; the classification should identify owner, purpose, authorised recipients, storage, transmission, marking, retention, legal hold, redaction, destruction, and the boundary between public and controlled criteria. Security restriction and legal privilege are distinct doctrines; a document does not become privileged merely because it is labelled confidential, and a privileged communication may still require secure handling.

The technical record should remain complete enough for authorised review; excessive fear of disclosure can produce vague specifications, undocumented oral decisions, missing photographs, or untraceable test data; those gaps weaken both engineering and legal defence; the correct response is controlled completeness. Public packages can state bounded functions and public methods. Restricted packages can contain authorised criteria, detailed vulnerabilities, room identifiers, and security dispositions. Legal advice can be separated from ordinary technical records while preserving the facts and calculations on which advice depends.

Claims avoidance begins with clear allocation. The contract should identify who owns design, delegated design, product selection, interface closure, testing, access, security, schedule, repair, and authority submissions. It should state that review does not relieve the submitting party of contractual responsibility unless the contract expressly reallocates it. It should define notice and preservation obligations after a failed test, damaged boundary, disputed measurement, or destructive examination. A hurried repair can erase the condition needed to determine cause and can create allegations of spoliation or concealment.

Expert-report readiness is not an instruction to litigate every project. It is a discipline of reproducibility. The record should enable a later competent reviewer to distinguish facts supplied by others, direct observations, calculations, professional opinions, authority decisions, and hypothetical illustrations. Photographs need identifiers and context. Data need native files, metadata, calibration, positions, processing, and checksums. Calculations need variables, units, assumptions, and sensitivity. Reports need scope and limitations. Opinions should be stated at the strength supported by evidence.[426][427][428][429]

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426 MB-1023. National Counterintelligence and Security Center, Public technical-security and counterintelligence resources.
427 MB-0239. ASTM International, ASTM E2713-25, ASTM E3176-24.
428 MB-1106. Office of the Director of National Intelligence, Intelligence Community Directive 705, Sensitive Compartmented Information Facilities.
429 MB-1109. Office of the Director of National Intelligence, Intelligence Community Standard 705-2, Standards for Accreditation and Reciprocal Use of SCIFs.

Dispute processes should preserve the facility's safety and security; access for opposing experts, insurers, contractors, or authorities may require escorts, device controls, redacted drawings, controlled test signals, and approved data rooms; these controls should not be manipulated to obstruct legitimate examination. The parties should agree a protocol that permits necessary observation while protecting controlled information and operations; where destructive opening is contemplated, the protocol should identify notice, witnesses, photographs, samples, chain of custody, testing, restoration, and the handling of unexpected conditions.

Contract language should avoid absolute promises such as "eavesdrop-proof" or "zero leakage"; the engineering basis should use measurable propositions, defined states, known limitations, and competent-authority decisions; this precision reduces ambiguity without diluting the required performance; it also prevents a favourable result under one method from being enlarged into a warranty against every acoustic, electronic, human, or operational threat.

Worked example 33.54. Failed field test under preservation protocol

A final room-pair test is below the contractual criterion in two bands; the contractor proposes immediate sealant work; the owner instead freezes the state, records door position, HVAC, masking, furniture, pressure, calibration, photographs, and raw data, then conducts agreed local diagnostics. The investigation identifies a duct bypass and a frame gap; repairs are documented separately and the formal test is repeated after the configuration is restored. The protocol preserves causation evidence while avoiding unnecessary opening of unaffected walls.

Table 33-7. Record classes and handling controls

Record class	Typical content	Minimum control	Technical consequence of poor control
Public technical record	Published methods, general design basis and non-sensitive summaries	Revision, source status and ordinary records management	Obsolete or unsupported public claims
Controlled project record	Detailed drawings, criteria, vulnerabilities, test data and room identifiers	Authorised access, secure storage, transmission and retention	Exposure, missing evidence or unreviewable decisions
Privileged legal communication	Legal advice, litigation strategy and counsel-directed analysis where applicable	Counsel-defined privilege and distribution controls	Waiver, confusion between fact and advice, or incomplete technical record
Native measurement and model data	Instrument files, scripts, calculations, configuration and metadata	Integrity manifest, software/version record and reproducible processing	Inability to replicate or test the conclusion
Physical evidence and samples	Hardware, seals, materials, destructive-opening samples	Identification, custody, storage and authorised examination	Lost causation evidence or disputed identity

33.55 Final acceptance, conditional use, and immutable closeout

Final acceptance should be a reasoned disposition of a defined configuration, not a ceremonial certificate issued because construction has ended. The acceptance dossier should identify each requirement, supporting evidence, unresolved limitation, uncertainty, responsible reviewer, authority decision, and change trigger. It should reconcile the as-designed, as-submitted, as-built, as-tested, as-authorised, and as-operated states. Where those states differ, the dossier should explain why the difference is acceptable or identify the action required before use.[430][431][432][433]

430 MB-1238. U.S. Department of Defense, UFC 4-010-05.
431 MB-1223. U.S. Department of Defense, DoD Manual 5200.01 family, Information Security Program.
432 MB-1095. ICD 705.
433 MB-1096. ICD 705.

Conditional acceptance is legitimate when conditions are explicit, controlled, and time bounded; a room may be permitted for a restricted use while one replacement component is pending, provided the authority understands the residual condition, compensating controls, expiry, monitoring, and closure evidence. Conditional acceptance is not a device for hiding incomplete work; the record should identify who may use the room, for what function, under which operating states, with which restrictions, and who can remove the condition; automatic expiry is preferable to an indefinite note that disappears into the handover archive.

Open items should be classified by effect; cosmetic work can be separated from conditions affecting acoustic, fire, structural, accessibility, electronic, security, documentation, or authority propositions; a room should not be labelled complete when a missing record prevents verification of a concealed condition. Conversely, the absence of a nonessential administrative item should not be misrepresented as a physical failure; the acceptance matrix should preserve these distinctions and should identify which evidence can close each item.

Closeout should be immutable in the evidentiary sense; the owner should freeze the issued drawings, room data sheets, approved submittals, inspection records, photographs, nonconformances, repairs, raw data, reports, calibration evidence, software baselines, authority decisions, manuals, spare-parts register, maintenance schedule, and change triggers. A manifest and cryptographic digests can make later byte-level alteration detectable; they do not establish that the files are true or complete; the technical and authority reviews establish meaning; the seal preserves the reviewed version.

A controlled release identifier should connect the dossier to the room and date. Superseded records should remain traceable rather than being overwritten. Later changes should create a new baseline with a delta register, affected requirements, inspections, tests, and authority disposition. The owner should avoid the common practice of retaining only the latest drawing while discarding the history needed to understand why a detail exists or which evidence supported the prior use decision.

Training and turnover complete acceptance. Custodians, facilities staff, security personnel, technology administrators, and maintenance contractors should understand doors, masking, HVAC modes, authorised pathways, software state, inspection indicators, alarm response, work permits, and escalation. Training should include demonstrations and records, not attendance alone. The room is accepted as a maintained system. Its continued validity depends on people recognising when the baseline has changed.

Worked example 33.55. Conditional acceptance with expiry

A protected meeting room satisfies construction, acoustic, and speech requirements, but one monitoring controller is operating on an approved temporary firmware version. The authority permits use for sixty days with local-only administration, weekly configuration verification, no remote access, and automatic suspension at expiry unless the final controller state is installed and retested. The closeout record carries the condition, responsible owner, evidence, expiry, and decision. The condition cannot be erased by issuing an otherwise clean completion certificate.

33.56 Cross-discipline compliance, accessibility, environmental conditions, and sustainability trade-space

Procurement must preserve acoustics without consuming structural capacity, fire resistance, smoke control, accessibility, moisture safety, indoor environmental quality, maintainability, or lawful egress; these obligations should be written as parallel propositions with named authorities and evidence; a heavier leaf can improve transmission loss while exceeding hinge, closer, frame, or supporting-wall capacity. A high-compression seal can reduce leakage while creating excessive opening force. A rigidly filled head joint can close an acoustic gap while defeating movement or fire-resistive construction; a longer silencer can improve insertion loss while increasing pressure loss, fan energy, access difficulty, or smoke-control complexity; the specification should expose these interactions before procurement rather than leaving installers to choose which obligation survives.[434][435][436][437]

Accessibility should be treated as a design input, not an exception requested after the acoustic doorset arrives. Clear width, threshold geometry, manoeuvring space, operating force, hardware reach, closing speed, vision, alarms, and assisted operation can alter leaf, frame, seal, vestibule, and control design. Where powered assistance is used, the specification should define normal, failure, fire, security, and emergency states, including the acoustic consequence of any latch release or door-open interval. The project should avoid claiming that accessibility and acoustic security are inherently

434 MB-1219. UFC 4-010-05, UFC 4-020-01.
435 MB-1100. Office of the Director of National Intelligence, ICS 705-02, Standards for the Accreditation and Reciprocal Use of Sensitive Compartmented Information Facilities.
436 MB-1102. UFC 4-020-01, UFC 4-010-05.
437 MB-1217. UFC 4-010-05, ASTM E336-25a.

opposed. The design task is to identify the complete operating envelope and select a system that performs lawfully within it.

Moisture and environmental conditions can change both performance and durability. Exterior glazing, historic masonry, below-grade construction, cold ducts, wet fire-protection systems, and porous finishes can encounter condensation, freeze-thaw action, corrosion, swelling, shrinkage, microbial growth, or seal degradation. Procurement should identify temperature and humidity ranges, water exposure, drainage, vapour control, compatible sealants, corrosion resistance, curing, storage, and inspection. A laboratory specimen tested in a stable indoor climate does not establish service life in a humid plant room or an unconditioned perimeter zone. Where environmental ageing is material, the owner should require appropriate product evidence, mock-up exposure, maintenance, and replacement triggers.

Sustainability claims require the same evidentiary discipline as acoustic claims. Recycled content, low-emitting materials, energy reduction, disassembly, repairability, local sourcing, embodied carbon, and long service life can all be valuable, but none should be accepted through marketing language alone when they affect a controlled assembly. Substituting lighter board, lower-density insulation, a different adhesive, thinner metal, or a new glazing interlayer can change mass, stiffness, damping, fire, smoke, moisture, and durability. The environmental benefit should be assessed against the complete technical configuration and the cost of premature replacement or failed commissioning.

Procurement documents should therefore include an interface compliance register. Each critical detail should identify acoustic, structural, fire, smoke, accessibility, moisture, environmental, security, and maintenance requirements; the supporting evidence for each; the responsible reviewer; and the change authority. The register prevents one discipline's approval from being misrepresented as universal acceptance. It also gives the contractor a visible route for resolving conflicts before work is concealed.

Worked example 33.56. Door option with interacting obligations

Option A provides a stronger laboratory acoustic result but requires an operating force above the accessible limit and has no powered-assistance failure analysis. Option B provides a lower nominal rating, satisfies accessible operation, and includes a tested vestibule arrangement, controlled frame, replaceable seals, and functional commissioning. The room-level path model shows only a 1.2 dB difference after wall, ceiling, and duct paths are included. Procurement selects Option B and strengthens the adjoining paths rather than purchasing an inaccessible door whose larger catalogue number would not govern the complete room.

33.57 Commissioning contract, deferred tests, seasonal states, and retest resources

Commissioning obligations should be procured before construction because final testing depends on access, temporary services, finished conditions, calibrated instruments, witnesses, operating staff, software state, and time for correction. The contract should identify the commissioning authority, test team, independent reviewer, responsible trades, authority witnesses, readiness criteria, methods, source states, room states, decision rules, diagnostic permissions, deficiency process, retest allocation, raw-data delivery, and final dossier. Without those provisions, the test team can arrive after ceilings are closed, furniture is installed, systems are unavailable, and the programme has no commercial mechanism to require correction.[438][439][440][441]

Retest responsibility should follow cause rather than be left entirely undefined; a contractor-caused defect, incomplete work, undocumented substitution, or failed readiness gate should ordinarily carry correction and retest obligations under the contract; an owner-directed change, new criterion, changed source state, or exceptional external condition may require a different allocation. The documents should also distinguish formal retest from local diagnostic measurement; repeating an entire room-pair test after every minor adjustment can be inefficient, while accepting only a local indicator after a major repair can be insufficient. The commissioning plan should define the evidence ladder.

Seasonal and deferred tests require explicit controls; exterior assemblies, HVAC performance, pressure relationships, plant noise, moisture, and some structural paths can vary with weather and operating load; a project completed in mild weather may not reproduce winter stack effect, summer cooling load, wet-system operation, or full occupancy. Where a required state cannot be tested at initial handover, the authority may permit a provisional disposition with a deferred-test plan, operating restrictions, baseline indicators, responsible owner, funding, expiry, and automatic escalation; a deferred test should not disappear when the construction team demobilises.

438 MB-1214. UFC 4-010-01, UFC 4-010-05.
439 MB-1114. ASTM E336-25a, ASTM E2638-24.
440 MB-1215. UFC 4-010-05, ASTM E336-25a.
441 MB-1226. U.S. Department of Defense, DoDM 5105.21, Volume 2, Change 2, SCI Administrative Security Manual: Administration of Physical Security, Visitor Control, and Technical Security.

The contract should preserve access and restoration. Diagnostic opening, temporary sealing, damper changes, branch muting, controller overrides, source relocation, or vibration interventions may be justified, but each can affect fire, structure, safety, cyber, security, finishes, and operations. The plan should identify who may authorise intervention, who observes it, how the modified state is labelled, and how restoration is verified. A favourable diagnostic state cannot be substituted silently for the formal as-operated result.

Retest resources should include contingency time, instrument availability, specialist labour, replacement materials, escorts, security review, and authority attendance. A schedule that permits only one test day and no correction cycle is not a realistic acceptance programme for a complex room. The project should use pretests and first-of-type measurements to reduce risk, but should retain enough time to investigate genuine defects rather than pressure reviewers to accept an unexplained result.

Final payment and release should connect to the evidence chain. Commercial completion can be staged, but the amount retained should be meaningful enough to secure outstanding correction, data, manuals, software exports, training, deferred testing, and authority records. Release should follow verified closure rather than the mere passage of time. The closeout manifest should identify any surviving provisional items and the mechanism that will keep them visible after turnover.

The commissioning contract should also preserve a single authoritative contact list for aftercare. Facilities, security, technology, fire protection, the test team, and the accepting authority must know who receives an alarm, failed trend, damaged seal, unapproved penetration, or expired condition.

An event without an owner becomes an unmanaged change, however complete the original test report appeared.

Worked example 33.57. Deferred full-load HVAC test

A room is completed before the central plant can operate at design summer load; quiet-state and normal-flow tests pass, but full-load duct breakout and pressure cannot yet be reproduced; the authority permits provisional use under a restricted occupancy and gain limit. The contract retains the testing allowance, assigns a summer test window, defines source and plant states, requires correction and retest if the criterion is missed, and expires the provisional disposition automatically; the room is not represented as finally accepted until the deferred evidence is closed.

33.58 Conclusions

Publication-ready secure-room procurement depends on traceability. The authorised use becomes owner’s requirements, a basis of design, room data sheets, coordinated drawings and specifications, procurement obligations, submittal evidence, inspection, tests and authority disposition. Each transition is explicit.

Performance requirements define results. Prescriptive requirements preserve mechanisms and obligations that a final number cannot prove. Submittals become progressively project-specific. Substitutions require multi-attribute evidence. Mock-ups prevent repeated defects. Acceptance matrices keep open requirements visible. Handover and change control preserve technical memory.

The extended procurement architecture adds five controls that are indispensable at publication level; the contractual hierarchy must reconcile conflicts rather than reward selective reading; quantitative schedules must preserve frequency, state, method, uncertainty, and proposition; interface matrices must assign physical and organisational ownership. Evidence review must test configuration and provenance, not document volume. Commercial and multinational processes must preserve technical equivalence and authority boundaries.

The central editorial rule remains simple: no document should claim more than its evidence. A brochure identifies a product. A test report identifies a specimen. A shop drawing identifies a proposed configuration. Inspection identifies observed construction. A field test identifies measured performance. The competent authority decides use.

Table 33-8. Publication-ready specification checklist

Specification subject	Required content	Release condition
Authorised use and source states	Occupants, speech, electronics and listener access	Confirmed by owner and authority
Measurands and methods	Laboratory, field and occupied quantities	Named standards and states
Prescriptive mechanisms	Geometry, materials, sequencing and interfaces	Coordinated details and listings
Submittal evidence	Complete reports, drawings and calculations	Reviewed before fabrication
Mock-up and hold points	First-of-type and concealed-work gates	Closed before repetitive work
Acceptance and uncertainty	Decision rule, test plan and repair	Agreed before testing
Handover and lifecycle	Registers, manuals, baseline and change triggers	Verified and checksum-sealed

Table 33-9. Submittal disposition categories

Disposition	Meaning	Contractor action	Project record
Approved	Conforms within reviewed scope	Proceed	Accepted submittal and baseline link
Approved as noted	Minor conditions require incorporation	Revise record and proceed as allowed	Noted conditions and confirmation
Revise and resubmit	Material evidence or design gap remains	Do not fabricate affected work	Open review comments
Rejected	Does not satisfy requirement or scope	Replace proposal	Reason and affected requirement

Disposition	Meaning	Contractor action	Project record
Informational	No approval intended	Retain for record	Metadata and distribution status

Table 33-10. Substitution comparison fields

Comparison field	Evidence required	Typical disqualifier
Acoustic spectrum and method	Complete laboratory or field report	Only a headline rating
Physical configuration	Dimensions, materials, mounting and interfaces	Different unanalysed frame or seal
Fire, smoke and structure	Current listings and calculations	Hybrid unlisted assembly
Durability and maintenance	Cycle, environment, replacement and access data	Unmaintainable concealed component
Security and electronics	Hardware, cabling, controls and approvals	Undocumented interface or remote function
Schedule and cost	Transparent effect and responsibility	Emergency request after procurement failure

Table 33-11. Acceptance dossier structure

Dossier class	Principal records	Controlling question
Requirements	Owner's requirements, basis and room data sheets	What was the project required to achieve?
Design	Drawings, specifications, calculations and reviews	How was the requirement addressed?
Procurement	Submittals, substitutions and qualifications	What was proposed and accepted?
Construction	Photographs, inspections and nonconformances	What was actually built?
Measurement	Methods, raw data, uncertainty and reports	What performance was observed?
Authority	Conditions, limitations and decision	What use was authorised?
Lifecycle	Manuals, baseline, changes and retest triggers	How will validity be preserved?

Chapter 33 Glossary

Acceptance matrix. Structured record linking each requirement to submittal, inspection, test and authority disposition.

Authority overlay. Jurisdiction-specific governance, document handling, review, witnessing, and use decision applied to a common engineering design basis.

Basis of design. Document explaining how the design responds to the owner's requirements, including assumptions, mechanisms, calculations and limitations.

Common data environment. Controlled information-management environment used to create, review, issue and archive project information.

Contractual hierarchy. Defined order and reconciliation process governing conflicts among criteria, drawings, specifications, schedules, submittals, instructions, and authority decisions.

Delegated design. Detailed design assigned contractually to a contractor or specialist under defined criteria and interfaces.

Evidence sufficiency. Degree to which evidence identifies the relevant object, configuration, method, state, limitations, provenance, and proposition strongly enough to support the intended decision.

First-of-type mock-up. Initial representative construction used to verify details, sequencing, workmanship and performance before repetitive release.

Hold point. Mandatory inspection or approval point beyond which work may not proceed without documented release.

Interface matrix. Controlled schedule assigning each physical and organisational junction to requirements, owners, deliverables, inspection, testing, and change authority.

Owner's project requirements. Statement of authorised function, outcomes, constraints, operations and evidence required by the owner.

Package-level procurement. Procurement of a complete interacting system, including products, interfaces, accessories, installation, commissioning, spares, and evidence, rather than an isolated component.

Performance specification. Requirement defining a measurable result and verification method while allowing controlled flexibility in means.

Prescriptive specification. Requirement defining materials, geometry, sequencing or workmanship needed to preserve a mechanism or obligation.

Production release. Documented authority to repeat a first-of-type configuration after evidence, defects, corrections, training, and sampling controls are closed.

Provenance. Traceable origin, custody, identity, revision, and transformation history of a product, document, model, data file, or evidence object.

Requirement traceability matrix. Ledger connecting each requirement to source, owner, design response, evidence and disposition.

Room data sheet. Room-specific record of authorised use, source and receiver states, construction, services, equipment, testing and lifecycle conditions.

Submittal. Contractor or supplier information submitted for review, such as product data, reports, drawings, calculations or samples.

Substitution. Proposed replacement of a specified product, assembly, method or system requiring documented equivalence review.

Witness point. Inspection point at which the reviewer is invited to attend but work may proceed under stated contractual conditions after proper notice.

Chapter 34. Construction Surveillance, Mock-Ups, Inspection Hold Points, As-Built Evidence, and Nonconformance Control

34.1 Construction surveillance as proof of the installed state

High-isolation rooms contain many conditions that can be observed only once; a resilient clip disappears behind board. Mineral-fibre cavity fill becomes inaccessible. A slab-edge seal vanishes above a suspended ceiling; a firestop is buried by escutcheons and equipment; door-frame anchorage, silencer connections and deck-flute closures are progressively hidden by ordinary sequencing. The surveillance programme must therefore be designed around the time at which a proposition can still be tested by direct observation. A visit made after concealment may confirm that a wall exists, but it cannot reliably establish the number of board layers, the absence of rigid bridges, the continuity of cavity absorption, or the geometry of the concealed perimeter.

The object of surveillance is not to watch labour continuously. It is to create sufficient, competent and traceable evidence that the installed work conforms to defined requirements and that material departures are detected before they propagate. The observer should know the requirement identifier, approved detail, relevant product and inspection method before arriving at the workface. The record should identify what was actually visible, what was measured, what remained inaccessible, and what inference is justified. When the observer merely writes “looks acceptable”, the record cannot support later engineering review because neither the comparison basis nor the observed particulars are recoverable.[442]

442 MB-1104. UFC 4-010-06, NIST SP 800-82.

Construction surveillance should also distinguish verification from approval; a competent observer can verify that two layers of 16 mm gypsum board were installed with staggered joints and specified fastener spacing; the observer may not possess authority to accept a departure from the tested assembly, waive a fire-resistance requirement, or authorise the room for protected use. Those decisions belong to the parties identified in the authority register; the surveillance report should therefore state facts, measurements and document references with clinical precision, while reserving dispositions for the assigned decision-maker.

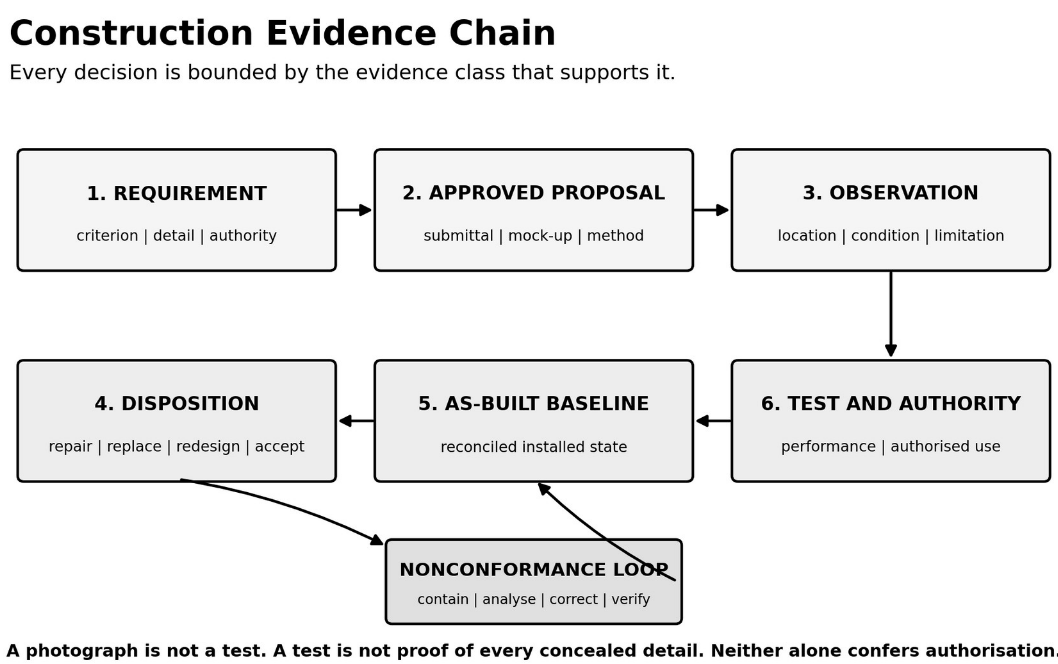

Figure 34-1. The construction evidence chain links requirement, approved proposal, observation, disposition, baseline and authority decision. Author's original diagram.

34.1.1 Observable proposition, evidence object and inference limit

Every surveillance activity should be framed as an observable proposition. "Partition conforms" is too broad. "The east face of partition P-14 at grid C/7 contains two identified board layers, with recorded joint offsets, fastener spacing and perimeter clearance before final closure" is observable; the evidence object may be an inspection form, dimensioned photograph set, measurement record, material label, approved drawing excerpt and release signature. The inference limit must then be stated; the observation may support the local area and time photographed, but not every metre of the partition unless the sampling rule and coverage justify that extension.

This proposition-evidence-inference structure guards against three common errors. First, it prevents the record from claiming more than the observer saw. Secondly, it prevents an isolated photograph from being treated as proof of a whole room. Thirdly, it exposes missing evidence before concealment, when the work can still be opened or supplemented at modest cost. ISO/IEC 17020:2026 emphasises competent, impartial and consistent inspection, while ISO 19011:2026 supports risk-based audit planning and evidence evaluation. Neither standard converts a sparse observation into comprehensive proof. The project must define the required coverage and decision rule.[443][444]

Worked example 34.1. Local evidence and room-wide inference

An observer photographs one correctly installed resilient clip in a wall containing 184 clips; the image proves the condition of that visible clip at that time; it does not prove that all 184 clips are correct; the surveillance plan therefore combines first-of-type inspection, systematic coverage of perimeter and service zones, and a recorded random sample of repetitive

443 MB-1221. UFC 4-010-05.
444 MB-1098. Office of the Director of National Intelligence, ICS 705-01, Physical and Technical Security Standards for Sensitive Compartmented Information Facilities.

field clips. The final conclusion identifies both the observed population and the residual uncertainty.

34.2 Governance, authority and surveillance scope

A secure-room project commonly contains several overlapping control systems. The contractor operates quality control. The designer performs contract administration and technical observation. The code regime may require special inspection. The commissioning provider verifies integrated performance. Security personnel control access and information. The acoustic consultant examines isolation-critical work. The authority having jurisdiction governs code matters. A competent security authority may determine whether the room is authorised for a protected function. These roles must cooperate, but they must not be blended into a single undefined “inspection team”.[445][446]

The construction-surveillance plan should contain a responsibility matrix that names who plans, observes, records, reviews, releases, directs correction, accepts residual risk and authorises occupancy; it should identify deputies, escalation routes and limits of delegation; the matrix should also state whether a role is first-party, second-party or independent. Independence is not an ornament. A manufacturer’s representative can provide valuable installation guidance, yet should not be the sole source of evidence for a disputed defect in that manufacturer’s product; likewise, a contractor’s quality-control record is necessary but may require corroboration where payment, concealment or high consequence creates a material conflict.

445 MB-1115. UFC 4-010-05.
446 MB-1105. Office of the Director of National Intelligence, ICS 731-02, Supply Chain Threat Revisions.

Scope should be expressed by systems and interfaces rather than by trade names alone; the acoustic boundary passes through framing, boards, masonry, doors, glazing, ceilings, floors, ducts, pipes, conduits, firestops, controls and structure; a trade-based surveillance plan can miss the interfaces between them. The plan should therefore allocate observations to boundary segments and path mechanisms; it should show who inspects the door-frame-to-wall joint, the duct-silencer-to-partition transition, the cable tray penetration through a fire-resistive acoustic barrier, and the wall head beneath profiled deck. Where responsibilities overlap, one party should own the integrated release.

The scope must also identify exclusions. Construction surveillance does not replace safety supervision, code inspection, laboratory accreditation, field acoustic testing or security accreditation. It may supply evidence to each process. It should never claim an authority it does not possess. The public governmental and international sources used here provide useful control principles, but project-controlled criteria and jurisdiction-specific authority remain governing.[447]

Worked example 34.2. Conflicting release signatures

The acoustic consultant signs a wall-head inspection form, while the fire-protection inspector leaves the corresponding joint open because the listed fire-resistive system has not been verified. The wall cannot be closed. The responsibility matrix requires both technical releases, with the construction manager recording a single integrated hold-point disposition. Acoustic acceptance cannot waive the fire requirement, and the fire review cannot ignore the acoustic movement joint.

447 MB-1115. UFC 4-010-05.

34.3 The construction-surveillance plan

The surveillance plan should be issued before the relevant work begins and treated as controlled project information. Its purpose is to translate specifications, approved submittals and risk analysis into an executable sequence of observations. A usable plan identifies the room and boundary, work packages, responsible organisations, prerequisites, notification periods, inspection methods, acceptance references, evidence formats, hold and witness points, nonconformance routes, security restrictions, record retention, and final reconciliation. ISO 10005:2018 and ISO 10006:2017 provide useful quality-plan concepts, while UFGS quality-control practice demonstrates the value of planned preparatory, initial and follow-up control.[448][449]

The plan should be organised at two levels; the programme level governs the whole project, including competence, communications, document control, imaging rules, issue escalation, audit and closeout; the work-package level governs a specific repeated activity, such as resilient wall framing, acoustic door installation, duct-silencer placement or penetration sealing. A generic plan alone cannot tell an inspector where a service sleeve is located or which approved detail governs it; conversely, a collection of isolated checklists cannot establish consistent authority, records and escalation.

A surveillance plan should contain revision triggers; revised drawings, substitutions, product changes, altered sequences, repeated defects, missed hold points, new subcontractors, changed access conditions and test

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448 MB-1216. UFC 4-010-05.
449 MB-1116. Office of the Director of National Intelligence, Version 1.5.1, Technical Specifications for Construction and Management of Sensitive Compartmented Information Facilities.

failures may all require the plan to be amended; the previous plan remains part of the record because it explains which controls were in force when earlier work was performed. A silent replacement destroys historical context.

Table 34-1. Minimum construction-surveillance-plan fields

Control field	Required content	Evidentiary purpose
Scope and boundary	Rooms, elements, interfaces, exclusions	Prevents unowned work and false completeness
Requirement basis	Requirement IDs, drawings, specifications, approved submittals	Establishes the comparison rule
Roles and authority	Observer, reviewer, release authority, escalation	Prevents unauthorised waivers
Timing	Prerequisites, notice, hold point, closure window	Preserves observability
Method	Visual, dimensional, documentary, photographic, test	Makes the inspection reproducible
Acceptance evidence	Required fields, images, measurements, signatures	Defines a complete record
Security controls	Personnel, devices, transfer, storage, distribution	Protects sensitive information
Nonconformance route	Classification, stop-work threshold, disposition and closure	Controls departures
Revision and audit	Change triggers, periodic review, audit sample	Preserves effectiveness
Handover	Register reconciliation, record format, retention and custodian	Creates the lifecycle baseline

34.3.1 Plan audit, revision control and field usability

A surveillance plan should be audited before issue against the approved requirement matrix, room data sheets, submittal log, construction programme and security plan. The audit asks whether every irreversible condition has an observation point, whether each observation has a competent assignee, and whether the evidence can be stored without violating project restrictions. It also checks whether the planned sequence is physically possible. A wall-head inspection requiring sight of the upper track cannot be scheduled after a ceiling grid has obstructed access, and a door-frame anchor inspection cannot depend upon photographs taken after the frame has been grouted or encased.

Revision control must reach the workface, not merely the document-management system. Each controlled copy should carry status, revision, issue date and supersession information. Changes to details, products, work sequence, authority or risk ranking should trigger a documented plan review. A revised plan should identify which completed work remains supported by the earlier method, which work requires supplemental evidence, and which future hold points have changed. The field version should be concise enough to use in gloves beside an unfinished wall, while linking to the full controlled criteria. A technically complete plan that cannot be understood or retrieved during active construction is administratively impressive but operationally defective.[450][451]

Worked example 34.3. Surveillance-plan readiness

A project intends to begin wall closure on Monday; the plan identifies the wall types and inspectors but contains no approved photographic device, file-transfer route or release signature. The work is not ready. By Friday, the project assigns a controlled camera, establishes the image index, confirms the acoustic and fire reviewers, and defines the release form; the technical work has not changed, yet the ability to prove it has.

450 MB-1218. UFC 4-010-05, UFC 4-010-06.
451 MB-0280. ASTM International, ASTM E336-25a, ASTM E2638-24.

34.4 Risk-ranked inspection coverage

Not every feature merits the same surveillance intensity; a repeated straight wall field, once a first-of-type unit has been released, may justify systematic sampling; a unique door threshold, complex slab-edge joint, large duct penetration or inaccessible wall head may require one hundred per cent observation. Risk ranking should consider consequence, defect likelihood, detectability after concealment, repetition, installer experience, assembly novelty, interface count and the availability of later performance testing; the result is an inspection allocation, not a declaration that unobserved work is conforming.

A useful first screen is the coverage ratio:

$$C = \frac{n}{N}$$

where C is the inspection coverage ratio, n is the number of work units inspected, and N is the number of comparable work units in the defined population. The ratio is dimensionless. It reports coverage, not effectiveness. Inspecting 90 per cent of the wrong characteristic can be less valuable than inspecting 20 per cent of the controlling interface. The population must therefore be homogeneous enough for the ratio to have meaning, and the selected units must not be limited to convenient locations.[452]

Risk categories should drive both frequency and method; critical concealed interfaces may require direct observation, dimensioned photographs and independent release; significant repeated work may require a first-of-type inspection followed by stratified random sampling and targeted checks at

452 MB-0978. JCGM 100:2008, JCGM 106:2012.

transitions. Routine visible work may be verified during normal quality rounds; when defects appear, the sample should expand and the previous population should be reconsidered. The surveillance plan should state this escalation rule before the contractor learns which areas have been selected.

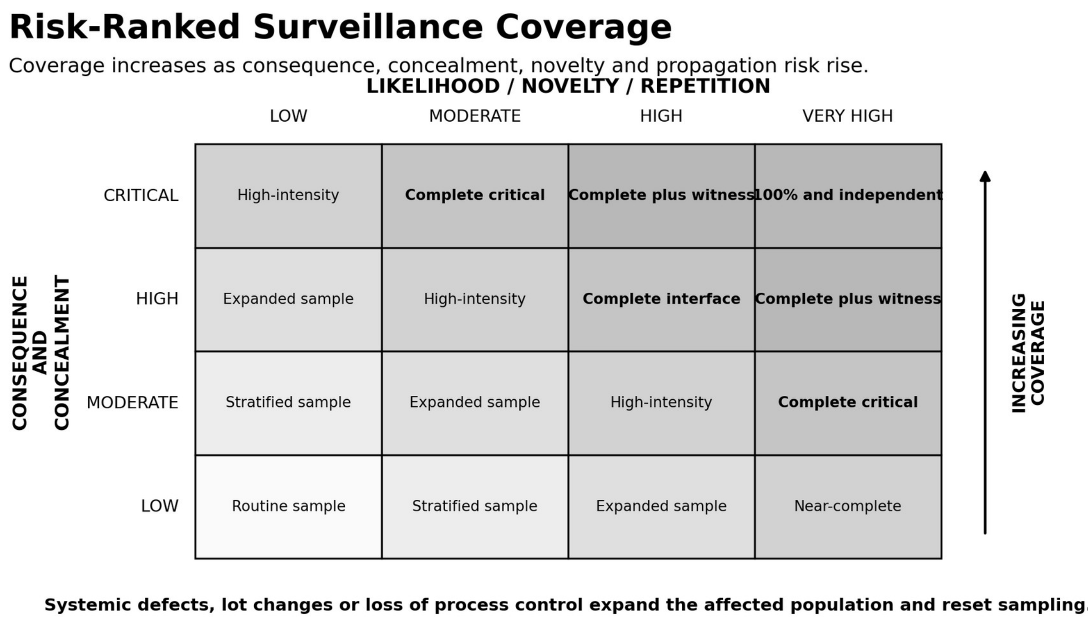

Figure 34-2. Risk-ranked coverage combines consequence, concealment, novelty and repetition to select surveillance intensity. Author's original diagram.

Table 34-2. Risk-ranked surveillance matrix

Condition	**Typical risk**	**Indicative surveillance response**	**Escalation trigger**
Unique concealed junction	Critical	100% direct observation and release	Any departure or inaccessible area
Repeated resilient wall field	Significant	First-of-type plus stratified sample	Bridge, spacing error or lot change
Door perimeter and threshold	Critical	100% inspection through adjustment	Failed seal contact or test anomaly
Minor visible finish	Routine	Normal quality-control observation	Evidence of substrate damage

Condition	Typical risk	Indicative surveillance response	Escalation trigger
Large service penetration	Critical	100% multi-discipline inspection	Unapproved sleeve or system mismatch
Repetitive small penetrations	Significant	Register reconciliation plus targeted sample	Missing labels or recurring seal defect
Factory-built silencer	Significant	Identity and installation verification	Model, orientation or transition change
Post-occupancy alteration	Critical	Change-control review and recommissioning	Any boundary penetration or hardware change

34.4.1 Adaptive sampling and the limits of extrapolation

Sampling should expand when observations contradict the assumptions that justified the original sample; a low defect rate in ordinary wall fields does not justify reduced attention at columns, door jambs, deck flutes or concentrated service zones because those strata contain different mechanisms. Likewise, one correctly installed production unit cannot support an inference about a later lot, crew, shift, subcontractor or revised detail; the sampling rule should identify the population, strata, selection method, escalation trigger and stopping condition before results are known.

Adaptive escalation can be expressed without pretending that site observations are a laboratory experiment; one major defect, two related minor defects, an unexplained material change, or evidence of systematic misunderstanding may require inspection of the affected population, not merely the next convenient unit. The expanded scope should run backward to the last verified control state and forward until the process again demonstrates stability; the record should distinguish observed conformity from statistical inference and should not attach a confidence percentage unless the selection process, independence assumptions and defect definition justify the calculation. Risk-ranked surveillance is strongest when it makes the limits of extrapolation visible, not when it disguises judgement beneath an unwarranted numerical sheen.

Worked example 34.4. Stratified coverage

A project contains 120 similar wall bays; twenty are at columns, 16 contain electrical boxes, 12 meet doors, and 72 are unobstructed; a simple sample of 12 bays could miss every high-risk interface; the plan instead inspects all door and column transitions, half the electrical-box bays, and a random sample of unobstructed bays. The total sample is larger, but more importantly, it reflects the defect mechanisms.

34.5 Personnel competence, independence and access

Competence must be matched to the observed proposition. A general superintendent may recognise poor workmanship but lack the acoustic knowledge to identify a rigid short circuit. An acoustician may understand flanking transmission yet be unqualified to judge a listed firestop installation. A security officer may control access but not determine fastener conformity. The project should define competence profiles for each surveillance class, including technical knowledge, relevant standards, assembly experience, measurement skill, reporting ability, security eligibility and familiarity with the approved documents.[453]

The plan should identify which observations require dual competence or coordinated attendance. Fire-resistive acoustic joints, for example, involve movement, listing fidelity, sealant geometry, backing material, substrate condition and acoustic continuity. One inspector may possess both

453 MB-1101. Office of the Director of National Intelligence, ICS 705-02, Standards for the Accreditation and Reciprocal Use of Sensitive Compartmented Information Facilities.

qualifications, but the record should demonstrate that competence rather than assume it. ASTM E3038-22a provides a useful framework for evaluating firestop inspector candidates, while ISO/IEC 17020:2026 addresses competence, impartiality and consistent operation of inspection bodies. These sources do not prescribe the project's acoustic qualifications, which remain to be defined.[454]

Independence should be calibrated to consequence. First-party contractor checks are indispensable because they operate continuously; second-party owner or designer observations provide contractual oversight; independent inspection or testing may be required for critical or disputed work; the project should record organisational relationships, commercial interests and prior involvement. Complete independence is not always possible, especially on small projects, but unmanaged conflict should never be concealed behind the word “inspection”.

Access conditions affect competence in practice. The observer needs timely site access, approved equipment, safe viewing positions, current drawings and sufficient light; secure sites may require escorts, device restrictions and limited work windows; these constraints should be priced and scheduled; an inspection rushed into the final ten minutes of an escort period is not equivalent to a planned observation, even when the same signature appears on the form.

34.5.1 Competence records and method authorisation

Competence should be demonstrated for the proposition being inspected. A general construction qualification does not necessarily establish the ability

454 MB-1100. Office of the Director of National Intelligence, ICS 705-02, Standards for the Accreditation and Reciprocal Use of Sensitive Compartmented Information Facilities.

to recognise a resilient-channel short circuit, evaluate an acoustical sealant joint, interpret a firestop listing, or assess a silencer connection. The project competence record should identify relevant education, trade experience, product training, inspection-method training, demonstrated field performance, limitations and expiry or renewal dates. Where specialised instruments are used, the record should also identify calibration, method competence and the authority to interpret results.[455]

Method authorisation should be separated from personal familiarity; the surveillance plan should state which observations may be made visually, which require measurement, which require a manufacturer or specialist, and which must be witnessed by an independent body. A newly assigned inspector may accompany an experienced inspector under supervision, but the report should disclose that status; security clearance or site access does not establish technical competence, just as technical competence does not confer access; by recording both dimensions, the project avoids the familiar but dangerous practice of assigning the only cleared person to make conclusions beyond that person's discipline. The result is not bureaucratic credential collecting. It is a defensible connection between the question asked, the method used and the person who signed the answer.

Worked example 34.5. Competence matrix

A door installation requires verification of frame anchorage, fire labelling, seal geometry, automatic-bottom operation, closer force and acoustic contact. The project assigns a door-and-hardware specialist and an acoustic observer to the first unit. After the method is validated, routine units are

455 MB-1224. U.S. Department of Defense, UFC 4-010-05.

checked by the trained quality-control manager, with the specialists returning for anomalies and final adjustment.

34.6 Preconstruction readiness and information release

The preconstruction conference is the last economical opportunity to align design intent, trade sequence, inspection timing and evidence production before material is fixed in place; it should review the approved requirement set, boundary drawings, shop drawings, substitutions, materials, work methods, sample units, hold points, notification periods, photographic restrictions, nonconformance procedure, and final records. Attendance should include the trades that create or penetrate the boundary, not merely the wall contractor; mechanical, electrical, communications, fire-protection, door, glazing, ceiling and controls personnel should understand which actions can invalidate the acoustic mechanism.

Readiness should be demonstrated by documents and physical conditions. Approved submittals must be available at the workface. Materials should be identifiable and properly stored. Substrates should be complete enough for inspection. Required access equipment, lighting and measurement tools should be present. The work area should not contain unresolved clashes that force improvisation. Where a controlled drawing set is used, the project should verify that each crew has the current authorised extract and that superseded sheets have been removed.[456]

A preconstruction release should not become a blanket permission to proceed indefinitely. It applies to the identified method, materials, personnel and conditions. A new subcontractor, altered detail, changed

456 MB-0438. 32 CFR Part 117.

board product, different clip, revised sealant or modified service route may require a renewed preparatory review. UFGS quality-control practice is valuable precisely because it treats preparation, initial execution and continuing follow-up as distinct controls rather than a single ceremonial meeting.[457]

Information security must be proportionate. Installers need enough detail to execute the work correctly, yet unrestricted circulation of complete vulnerability-sensitive models may be unnecessary. ISO 19650-5:2020 supports security-minded information management throughout the asset lifecycle. The project can issue role-specific work packs that show dimensions, interfaces and requirements while controlling unrelated sensitive information.[458]

Worked example 34.6. Superseded detail at the workface

A ceiling crew is preparing to cut a wall-head barrier using Revision 3, while the approved construction set is Revision 5. The preconstruction check detects the discrepancy before cutting. The controlled work pack is replaced, the crew acknowledges the revision, and the document issue is recorded. No nonconforming opening is created.

34.7 First-of-type mock-ups as release gates

A first-of-type mock-up is a representative installation used to prove that the approved design can be built, inspected, documented and, where required, tested before repetition; it should contain the controlling difficulties rather than a pristine wall field. Representative junctions, wall heads, bases,

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457 MB-1254. U.S. Department of Energy, ICD 705.
458 MB-1301. U.S. General Services Administration, 2025 PBS Core Building Standards and 2024 P100 reference materials, Facilities standards for the Public Buildings Service.

corners, doors, glazing, penetrations, firestops, ceilings, ducts and services should be included in proportion to the project risk; a sample that omits the interfaces most likely to fail is a showroom, not a construction-control instrument.

The first-of-type process should verify four matters. First, the proposed assembly and materials correspond to the approved evidence. Secondly, the sequence allows critical conditions to be inspected before concealment. Thirdly, the trades can achieve the required tolerances without improvised bridging or unapproved products. Fourthly, the evidence package can be produced efficiently and consistently. The mock-up therefore tests the surveillance system as much as the physical work.[459]

Release should be explicit. The record should identify the accepted configuration, permitted minor variations, unresolved conditions, workmanship benchmarks, photographic exemplars, repair methods and circumstances requiring renewed first-of-type review. Acceptance of the mock-up does not waive later conformity. If production work deviates, the mock-up becomes the comparison standard that exposes the departure.

459 MB-1098. Office of the Director of National Intelligence, ICS 705-01, Physical and Technical Security Standards for Sensitive Compartmented Information Facilities.

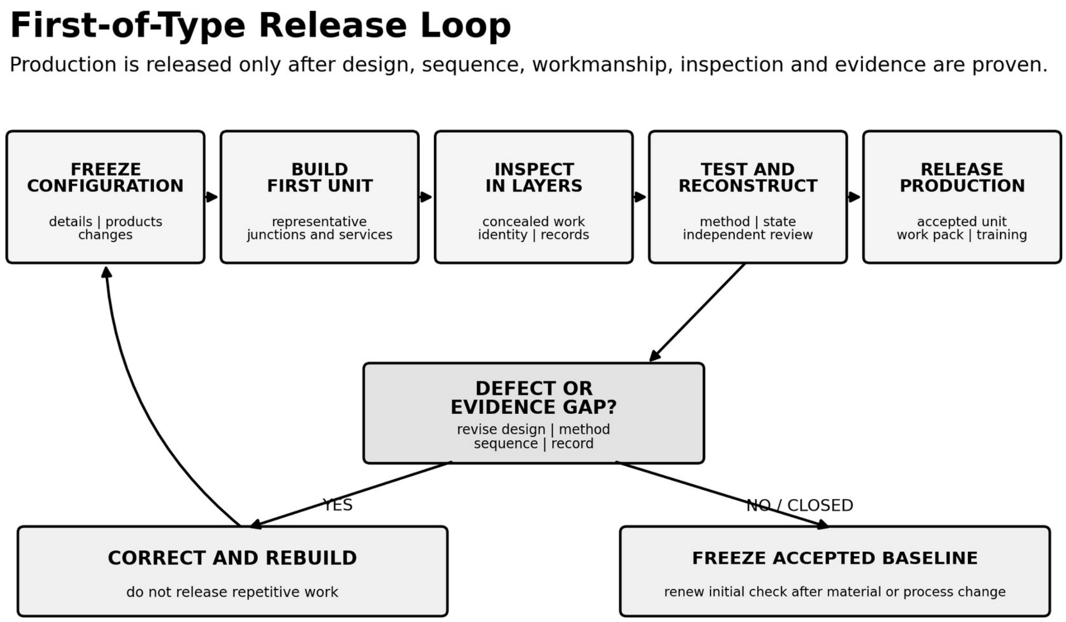

Figure 34-3. The first-of-type release loop proves design, sequence, workmanship, inspection and evidence before repetition. Author's original diagram.

34.7.1 Release criteria and production surveillance

The release decision should be based on defined criteria rather than collective satisfaction; typical criteria include approved material identity, dimensional conformity, continuity, movement capacity, absence of rigid bridges, penetration treatment, door or glazing fit, fire-system compatibility, accessibility for inspection, complete evidence and successful pretesting where specified. Open items should be classified. A cosmetic item may remain on a punch list; a concealed continuity defect prevents release.

Once released, production surveillance should compare each repeated unit with the first-of-type baseline; the comparison should recognise authorised variability; field dimensions may change, but the mechanism must remain intact; a larger gap, different frame anchor or altered service route requires analysis, not automatic rejection or casual acceptance. The release package should make that analysis possible by recording what features were essential.

Worked example 34.7. Mock-up that omits the controlling path

A wall mock-up achieves excellent laboratory-style appearance but contains no door, head-of-wall joint or electrical penetration; during production, the first door frame creates a rigid bridge and the first cable tray defeats the barrier; the project rebuilds the mock-up to include those interfaces and does not release further rooms until the integrated unit passes inspection and targeted field checks.

34.8 Sample panels and workmanship benchmarks

Sample panels serve a narrower purpose than first-of-type mock-ups; they establish acceptable finish, joint treatment, sealant profile, labelling, fastener repair, perimeter appearance or other workmanship characteristics that can be judged visually or dimensionally; they are useful where words such as “continuous”, “tooled”, “fully bedded” or “neatly fitted” require a visible benchmark. They do not, by themselves, establish complete assembly performance.

A workmanship benchmark should show both acceptable and unacceptable conditions where ambiguity is likely; a sealant sample can display correct backing depth, adhesion surfaces, hourglass profile and finished bead alongside examples of three-sided adhesion, inadequate depth and smeared surface. A resilient-channel sample can show correct fastener placement and an intentionally bridged condition; the physical contrast trains installers and improves consistency without replacing the approved details or standards.

Sample panels should be identified, dated, protected and retained until the relevant work is complete. Photographs alone may not preserve tactile properties, depth or stiffness. Where the panel cannot remain on site, a controlled image set and dimensioned record should be made before removal. The benchmark should also state which properties are not demonstrated. A sealant bead can show workmanship but not ageing, adhesion under every substrate condition, or acoustic performance of the completed wall.[460]

Worked example 34.8. Sealant benchmark

A 1 m sample panel contains four perimeter-joint conditions; the accepted sample uses the specified backer, clean substrates and a measured bead depth; three rejected samples show missing backing, excessive depth and rigid grout contamination; installers sign the briefing record and use the accepted panel during initial production checks.

34.9 Hold points, witness points and notification windows

A hold point is a contractual stop beyond which work may not proceed until the named release has been issued. A witness point invites attendance, but work may proceed after proper notice under stated conditions. The distinction must be explicit. A form that labels every observation a “hold point” while allowing routine closure without release drains the term of meaning and invites dispute.

Hold points should be placed immediately before irreversible concealment or high-cost propagation. Typical points include completion of framing and resilient supports, placement of cavity absorption, completion of inner

460 MB-1220. UFC 4-010-05.

board layers, wall-head and perimeter sealing, door-frame anchorage, penetration and firestop installation, duct-silencer connections, raised-floor barriers and first-of-type completion. The release package should contain the applicable drawing, requirement identifiers, inspection record, photographs, measurements, material identity, open-item status and signatures.

Notification periods should reflect access and consequence. A requirement for forty-eight hours' notice is useless when the inspector needs a security escort, lift, specialist and controlled camera that require a week to arrange. The plan should state working-hour conventions, cancellation rules and the response to late notice. Contractors should not be penalised for a reviewer who fails to attend after proper notice, but neither should a missed attendance automatically release critical work unless the contract expressly provides a substitute evidence method.[461]

A screening estimate of missed-defect probability can be written as:

$$P_m = \left(1 - p_d\right)^m$$

where P_m is the modelled probability that a specified defect escapes m independent detection opportunities, and p_d is the estimated probability that one opportunity detects the defect when present. Both are dimensionless. The model assumes independence and a stable detection probability, assumptions rarely satisfied perfectly on a construction site. Its value is pedagogical. It shows why repeated independent checks can reduce escape risk, but not eliminate it.[462]

461 MB-1103. UFC 4-010-06, NIST SP 800-82.
462 MB-1099. ASTM E336-25a, ASTM E2638-24.

Table 34-3. Hold-point schedule fields

Field	Required entry	Failure prevented
Hold-point ID	Stable identifier linked to requirement	Lost traceability
Work location	Room, grid, elevation and boundary segment	Ambiguous evidence
Trigger	Observable completion state before concealment	Premature call
Notice	Lead time, channel and required attachments	Unavailable inspector
Participants	Trade, quality control, specialist, security and code roles	Missing competence
Evidence	Forms, images, measurements, labels and drawings	Unsupported release
Release authority	Named role and permitted conditions	Unauthorised waiver
Open-item rule	What may remain and what prevents closure	Concealed critical defect
Missed-point remedy	Opening, enhanced evidence, test or redesign	Informal acceptance after concealment
Record destination	Register, repository, file naming and retention	Lost lifecycle evidence

34.9.1 Hold-point release test

Before release, the reviewer should perform a compact but explicit test; first, confirm that the identified inspection unit is complete enough to examine but not yet concealed; secondly, confirm that the controlled drawing, approved submittal and applicable change notices are current. Thirdly, verify that the required evidence has been produced, including measurements, labels, photographs and related code or security releases; fourthly, search for open nonconformances affecting the unit or an upstream interface. Fifthly, record any limitation, conditional item and the exact scope of the release. A signature without these elements can become a ceremonial mark whose meaning varies between participants.

The release should apply only to the inspection unit named in the record; it should not be copied across rooms, floors or later production unless the plan expressly defines a first-of-type or sampling inference; where several disciplines share the hold point, the integrated release should show each required decision and should prevent one completed signature from obscuring another missing approval. Electronic workflows can enforce required fields and timestamps, but they should permit the reviewer to refuse the release and explain why; the system must not convert silence, absence or an expired response period into technical acceptance unless the contract has deliberately created that consequence and a safe substitute evidence route exists.

Worked example 34.9. Notice-window failure

A contractor gives two hours' notice before closing a wall head that requires a controlled-area escort and a mobile platform. The inspector cannot attend. The contract defines seventy-two hours' notice and no substitute for this critical joint. Closure is deferred. The resulting schedule impact is recorded against late notice rather than converted into an undocumented waiver.

34.10 Concealed-work inspection and release

Concealed-work inspection should begin with a clean workface and a defined viewing state; temporary debris, stored board, insulation packaging and trade equipment can obscure the very conditions being examined; the observer should be able to see the full boundary segment, trace every penetration, verify material labels and take dimensions. When a condition cannot be seen, the record should say so rather than infer conformity from adjacent work.

The release should proceed in layers. Framing geometry and isolation are verified before cavity work. Cavity absorption and embedded services are verified before the first leaf closes. Inner layers, joints and perimeters are verified before outer layers obscure them. Penetrations and firestops are verified before escutcheons or ceiling closure. This layered sequence produces a cumulative evidence packet that follows the physical assembly. It also allows a defect to be corrected before it is multiplied by later finishes.[463][464]

The observer should compare the work with the exact approved configuration, not a generic detail recalled from experience. The comparison includes dimensions, product identity, orientation, fastener type and spacing, joint offsets, clearances, backing, sealant depth, movement provision, service separation and interfaces. Where the approved documents conflict, the hold point remains open until a controlled resolution is issued.

463 MB-0441. Defense Counterintelligence and Security Agency, NISP Oversight and Security Review Process, National Industrial Security Program oversight, review and rating resources.
464 MB-1225. U.S. Department of Defense, 32 CFR Part 117.

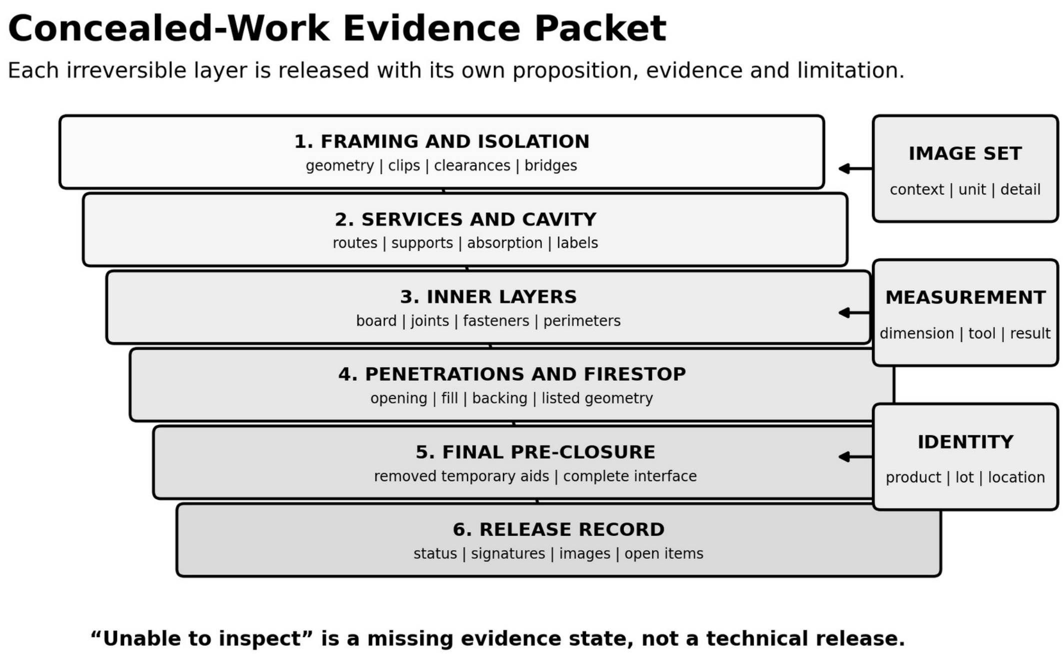

Figure 34-4. A concealed-work evidence packet accumulates layer-specific observations before each irreversible closure. Author's original diagram.

34.10.1 Release status and conditional closure

Release statuses should be few and unambiguous. "Released" means the defined work may proceed. "Released with recorded minor items" should be limited to conditions that cannot affect the concealed mechanism and have a clear closure path. "Not released" prevents concealment. "Unable to inspect" is not a technical acceptance. It triggers the missed-hold-point procedure.

Conditional closure is dangerous when the condition will become inaccessible; a promise to correct a hidden cavity defect later is not credible unless the correction method and access are real; conditional release is more appropriate for visible labels, surface cleaning or record completion that can be verified without opening the assembly. The release authority should refuse administrative convenience where physical observability will be lost.

Worked example 34.10. Layered wall release

The framing and resilient clips pass inspection, but the cavity contains a conduit strapped rigidly between both leaves; the wall is not released for boarding; the conduit route is altered, isolation clearances are measured, and the corrected condition is photographed. Because the defect was found before closure, the repair takes one hour rather than several days of demolition and restoration.

34.11 Material identity and provenance

Conformity begins before installation. A product can be visually similar to the approved item yet differ in density, thickness, stiffness, facing, formulation, fire classification, movement capacity or manufacturing tolerance. The surveillance system should therefore preserve material identity from delivery through incorporation. The record should identify manufacturer, product designation, relevant model, dimensions, lot or batch where supplied, serial number where applicable, delivery date, approved-submittal reference, storage location and final installation location.

Material provenance is especially important for acoustic doors, seals, resilient supports, damping products, specialised boards, silencers, glazing systems and firestop components; labels should be photographed before they are hidden or discarded; packaging alone is weak evidence because unused packaging can be moved between work areas. The strongest record combines delivery documentation, product labels, controlled issue to the workface, observation of installation and reconciliation of quantities; for serialised equipment, the serial number should follow the asset into the door, silencer, control panel or other installed location.

Substitution control remains active during construction. A purchasing department may obtain a different product because the approved one is delayed. A subcontractor may use a familiar sealant or framing member. A manufacturer may revise a product while retaining a trade name. The surveillance plan should require any difference to be referred before incorporation. “Same manufacturer” and “same headline rating” do not establish equivalence. The Chapter 33 substitution dossier remains the governing method.[465]

Table 34-4. Material-identity and provenance record

Field	Example content	Verification source
Requirement and submittal	RQ-AC-214; SUB-09-017 Rev 2	Requirement matrix and approved submittal
Manufacturer and product	Exact legal manufacturer and model	Label, data sheet and purchase record
Physical attributes	Thickness, density, dimensions, orientation	Measurement and product marking
Lot, batch or serial	Factory identifier and production date	Label or certificate
Delivery and custody	Date, carrier, receiving inspection, storage zone	Delivery ticket and site log
Storage condition	Dry, protected, temperature limits, damage status	Daily inspection record
Installed location	Room, grid, elevation, assembly layer	Photograph and as-built register
Quantity reconciliation	Delivered, rejected, unused and installed	Inventory and waste record
Change status	Approved substitution or deviation reference	Change register

465 MB-1097. ICD 705, UFC 4-010-05.

Field	Example content	Verification source
Final disposition	Accepted, quarantined, returned or destroyed	Material-control record

34.11.1 Quantity reconciliation and counterfeit or misrepresented product screening

Quantity reconciliation strengthens provenance because it connects documents to physical incorporation; the project should compare quantities ordered, delivered, rejected, quarantined, issued, installed, wasted and returned; large unexplained differences can indicate misplaced stock, use outside the approved area, substitution, duplicate documentation or weak recording. Reconciliation is especially useful where labels disappear during installation, such as cavity insulation, board layers, sealants, fasteners and firestop components; it does not prove correct installation, but it can expose a documentary narrative that is physically improbable.

Counterfeit or misrepresented product screening should be proportionate to consequence and supply-chain risk. Warning signs include altered labels, inconsistent fonts or batch formats, damaged seals, certificates that do not match the shipment, implausible manufacturing dates, missing traceability codes, packaging inconsistent with the manufacturer's published form, and products whose dimensions or mass depart materially from the approved data. Suspect material should be quarantined before destructive testing or return, since handling may affect evidence; verification may involve the manufacturer, accredited laboratory, procurement authority or legal counsel; the surveillance record should describe observable discrepancies without making unsupported allegations of fraud. The technical duty is to prevent uncertain material from entering the boundary and to preserve the facts needed for an authorised determination.

Worked example 34.11. Identical packaging, different product

Two pallets bear the same manufacturer's brand and colour. One contains ordinary 12.7 mm board, while the approved assembly requires 15.9 mm high-density Type X board. The receiving inspection photographs the edge markings, detects the difference and quarantines the incorrect pallet before it reaches the secure-room floor. Brand recognition alone would have failed.

34.12 Lot, batch, serial, storage and environmental control

A compliant product can become nonconforming through storage or handling; gypsum board exposed to moisture may distort or lose integrity; sealants stored beyond temperature limits can change application behaviour; resilient pads can be contaminated with oil or compressed under stacked loads. Door seals can be kinked, silencers can be damaged internally, and glazing units can lose edge protection. The surveillance plan should therefore include storage inspections proportionate to material sensitivity, with quarantine procedures for damaged, expired or uncertain stock.

Lot and batch records support two forms of reasoning; they permit targeted containment when a manufacturing or installation problem is discovered, and they help distinguish a local workmanship defect from a broader product issue; if a sealant batch fails adhesion at several locations, the project can identify every joint where that batch was installed. Without that record, the investigation may require opening or testing the entire population.

Serial control should not become indiscriminate bureaucracy; ordinary screws need not be serialised; a high-consequence door assembly, automatic bottom, electronic lock, silencer or vibration isolator may warrant serial or model capture because replacement parts and later maintenance depend upon exact identity. The quality plan should define the granularity before delivery, otherwise installers will discard useful labels as ordinary packaging.

Environmental records should be tied to the installation method. Temperature, humidity, substrate moisture, cleanliness and curing time may affect sealants, adhesives, coatings and concrete interfaces. The record should identify the measuring instrument where a quantitative limit applies. A weather application that merely states “conditions acceptable” cannot later demonstrate compliance with a specified range.

Worked example 34.12. Batch containment

Adhesion tests reveal that an acoustical sealant bead has not bonded to a painted substrate. The batch register shows that the same lot was used in six rooms during two shifts. Those joints are isolated for inspection, while rooms using other lots remain outside the immediate containment boundary. The register reduces destructive investigation from thirty rooms to six.

34.13 Framing and resilient-isolation inspection

Framing establishes geometry, stiffness, cavity depth and the mechanical connections through which structure-borne energy can travel; surveillance should verify member type, gauge or thickness, spacing, orientation, anchorage, deflection tracks, gaps, offsets, bracing and contact with adjoining construction. The observer should look especially for unplanned blocking, continuous backing, straps, conduit supports and temporary braces that bridge separated leaves; a small steel connection can defeat the intended resilience while remaining invisible after boarding.

Resilient channels, clips, hangers and isolators require configuration-specific inspection. The direction of channels, clip spacing, load limits, fastener location, edge distances and attachment sequence should match the approved system. Screws used to attach board must not penetrate through the resilient member into the supporting stud where the design depends on decoupling. Clips should not be bent, overloaded or packed with rigid shims. Perimeter clearances should allow the isolated leaf to remain free of rigid contact.[466]

Inspection should be performed under realistic loading where practical; a ceiling hanger that appears free when unloaded may contact a service or structure after board, lights and diffusers are installed; door frames and equipment supports can pull adjacent framing out of alignment. The plan should identify which checks occur before and after load application, and which clearances require measurement rather than visual judgement.

A framing record should include panoramic context and close views; a close photograph of a correct clip is meaningless if its wall location cannot be determined; conversely, a wide image cannot show fastener penetration; the image set should connect overview, mid-range and detail views through stable identifiers.

34.13.1 Bridge-detection protocol before closure

A bridge-detection protocol should examine every intended resilient separation as a continuous path rather than as isolated components. The

466 MB-1097. ICD 705, UFC 4-010-05.

observer traces studs, clips, channels, furring, blocking, services, edge trims, fasteners, bracing and temporary supports from floor to head and around openings. Particular attention belongs at corners, door frames, heavy equipment supports and transitions to conventional construction, where installers may add rigid material to solve an alignment or load problem. The protocol should include clearance measurements, fastener-length checks, visual tracing and, where justified, gentle mechanical probing that will not damage the assembly.[467]

Temporary construction aids must be removed and verified; packers, clamps, screws, timber braces and levelling shims can remain hidden after serving a legitimate installation purpose; a photograph taken before their removal can misleadingly preserve the defect as though it were an approved step. The evidence sequence should therefore include both the installation state and the final pre-closure state; when the system contains many repeated isolation points, the observer should inspect all high-consequence transitions and a recorded sample of ordinary field points, expanding coverage when any bridge is found. One rigid contact can dominate the behaviour of a carefully detailed resilient system, so the inspection method should favour path continuity over superficial neatness.

Worked example 34.13. Hidden screw bridge

During the initial wall unit, an installer uses 45 mm screws for the outer board layer. Several screws pass through the resilient channel into the studs, creating rigid bridges. The first-of-type inspection detects the error, establishes the correct screw length and demonstrates a depth-stop

467 MB-1074. National Protective Security Authority, Secure Working Areas, public guidance current at source freeze. Status at the 14 August 2026 source freeze: Current public guidance. Public locator: Use is confined to the source scope. The document d.

method. Production does not begin until the crew repeats the installation correctly.

34.14 Board layers, joints, fasteners and cavity work

Multi-layer gypsum assemblies depend upon more than nominal board count. Surveillance should verify product identity, thickness, orientation, joint offset, fastening pattern, edge support, damaged-area repair, perimeter clearance and treatment of penetrations. Inner-layer joints may be required to be sealed, finished or merely fitted according to the tested or approved assembly. The observer should not impose an invented treatment, but should verify the exact configuration represented by the evidence.[468]

Joint staggering should be recorded both within a leaf and, where relevant, between opposite leaves; repeated vertical joints can create weak lines, while unplanned backing added to support a joint can create a structural bridge; fastener spacing should be measured at representative and high-risk locations. Overdriven screws, torn face paper and missed framing can reduce attachment quality; repairs should be documented before the next layer hides them.

Cavity absorption should fill the intended area without compression that creates rigid contact or voids that expose paths; batts should fit around services and framing, not be pushed aside for convenience; the inspection should distinguish acoustic cavity absorption from fire safing or thermal insulation because the products and purposes may differ. Loose fibres or debris should not contaminate seals or door hardware.

468 MB-1072. National Protective Security Authority, Secure Rooms, public guidance current at source freeze. Status at the 14 August 2026 source freeze: Current public guidance. Public locator: Use is confined to the source scope. The document does not.

Board storage and acclimatisation matter. Warped or wet panels can force installers to use excessive fastening or leave open joints. ASTM C840-25 addresses application and finishing requirements, while GA-600-2024 provides tested fire and sound assemblies. The surveillance record should preserve which source controls each feature, rather than treating every recommendation as a universal rule.[469]

Worked example 34.14. Staggering failure at a hidden layer

The first inner board layer on a long wall contains a continuous vertical joint at every stud bay because half sheets were installed in a repeating pattern. The next layer would have hidden the geometry. Inspection stops the work, the affected boards are rearranged, and the revised layout is recorded as the production benchmark.

34.15 Wall heads, bases, corners and structural junctions

The clear wall field often performs better than its perimeter; wall heads must accommodate deflection or movement without opening a leak or creating a rigid short circuit; bases must remain continuous around floor finishes and raised systems. Corners and intersections must preserve mass, separation and seal continuity; structural columns, beams, deck flutes and slab edges create three-dimensional paths that cannot be resolved by a two-dimensional wall-type symbol.

Surveillance should verify joint width, backing, sealant depth, adhesion surfaces, movement provision and continuity behind intersecting finishes. At profiled deck, each flute and irregular cavity should be addressed by an approved detail. At a concrete soffit, laitance, dust or unevenness may

469 MB-0445. FCDO Services and UK National Authority for Counter-Eavesdropping, Secure Speech Environments.

prevent adhesion. At a floating floor, the wall base may need isolation from the structural slab or finish. The observer should examine the entire line, not only convenient sections.[470]

Corners deserve particular attention. Board layers may be omitted where access is tight, framing may be tied rigidly across separated leaves, and sealant may not continue behind corner bead or finishes; a tee intersection can transmit energy through continuous studs or backing. Where the design intentionally uses structural continuity, the acoustic model should have accounted for it; surveillance cannot repair a flawed design by documentation, but it can detect a field condition that differs from the model.

Movement joints should be inspected before and after adjacent finishes. A joint filled correctly at one stage can be bridged later by plaster, flooring, skirting, ceiling grid, cable tray or casework. The hold-point schedule should therefore include interface follow-up, not merely initial sealant installation.

Worked example 34.15. Deflection joint bridged by finish

A head-of-wall joint is correctly sealed and released; two weeks later, a plastering crew fills the visible movement gap with rigid compound to create a smooth line; follow-up surveillance detects the bridge before ceiling closure; the compound is removed, the approved finish detail is reinstated, and the finishing crew receives a marked interface drawing.

34.16 Doors, frames, seals, thresholds and hardware

The doorset is a dynamic assembly. Its acoustic performance depends upon leaf construction, frame anchorage, frame-to-wall sealing, hinges, latch

470 MB-1025. National Cyber Security Centre, TEMPEST and electromagnetic security public information.

engagement, closer control, perimeter seals, meeting stiles, automatic bottoms, threshold geometry, floor level and user operation. Surveillance must therefore continue from rough opening through installation, adjustment and final testing. A door photographed while open cannot demonstrate seal contact, and a door that seals when new may fail after hardware settles.[471]

Frame inspection should occur before the surrounding wall is closed; the observer should verify model, dimensions, anchor type and spacing, grout or fill where specified, isolation details, plumb, square and perimeter gap; unapproved grout can alter stiffness or bridge separated construction. Excessive shimming, twisted frames and misaligned anchors can prevent uniform contact; the frame-to-wall joint should be inspected from both sides where the design requires continuity.

Seal inspection should use a defined method; visual light checks, feeler gauges, transfer media, paper-pull checks and manufacturer procedures can identify contact, but each has limitations; the record should state the door state, latch condition, closer action, floor finish and environmental pressure. Automatic bottoms require drop timing, parallel contact and adequate clearance when open; thresholds should be firmly supported without creating an unsealed path beneath the frame.

Hardware changes must be controlled. A substituted closer, electric strike, power transfer, card reader or protective plate can alter forces, penetrations and seal contact. Maintenance staff should receive the final schedule and

471 MB-1074. National Protective Security Authority, Secure Working Areas, public guidance current at source freeze. Status at the 14 August 2026 source freeze: Current public guidance. Public locator: Use is confined to the source scope. The document d.

adjustment criteria because doors are among the most frequently disturbed boundary elements.

34.16.1 Doorset operating-state matrix

Door surveillance should use an operating-state matrix because a doorset can appear correct while stationary and fail during closing, latching, pressure change or emergency operation. The matrix should include fully open, initial closing, seal engagement, latch engagement, closed and unlatched, closed and latched, access-controlled release, fire-alarm state, power-loss state, automatic-operator state and the relevant room-pressure conditions. For each state, the observer records leaf position, frame clearance, seal contact, threshold engagement, hardware interference, operating force and any audible or visible leakage indication.

The matrix should be repeated after floor finishes, wall finishes, access-control commissioning and pressure balancing because these later works can change clearances and closing energy; a successful factory or early site inspection does not protect against threshold build-up, hinge settlement, closer adjustment or cable-transfer interference. Where the door is part of a sound lock, both leaves and interlock logic should be assessed together under realistic sequence; the evidence should identify the exact leaf, frame, seals, hardware and controller revisions. This operating-state approach prevents a static photograph of a handsome, heavy door from becoming a substitute for proof that the complete doorset closes, compresses, latches and remains maintainable in every authorised mode.

Worked example 34.16. Door passes open inspection and fails closed inspection

The frame, anchors and perimeter seal appear correct before leaf hanging. Once the heavy leaf is installed, the hinge jamb deflects and the head seal loses contact over 300 mm. The final doorset inspection detects the gap. Additional approved anchorage and adjustment restore uniform contact before acoustic testing.

34.17 Glazing and vision-panel surveillance

Glazing systems should be inspected as assemblies comprising glass, air spaces, frames, stops, gaskets, sealants, anchors and adjoining construction. The glass type and thickness must match the approved configuration, but performance can be lost through an unsealed frame perimeter, rigid bridge, short air space or unintended connection between isolated leaves. Laminated and insulating units should be identified by markings, certificates or delivery records before labels are removed.

Frame cavities and setting blocks are often concealed early; surveillance should verify support locations, bite, edge clearances, gasket continuity, drainage provisions where applicable and the relationship between acoustic and fire or safety requirements; where double independent frames are used, the observer should confirm that fixings and finishes do not connect them. A decorative trim spanning both frames can create a bridge after the primary glazing work has passed inspection.

Vision panels in doors require integrated review with the leaf listing and seals. Field enlargement of an opening, substitution of glass or change of bead can invalidate both acoustic and fire evidence. The surveillance record should connect the vision-panel assembly to the door serial number and approved shop drawing.

Post-installation cleaning and protective-film removal can expose damage. Scratched glass is visible, but displaced gaskets or cut sealant may be less obvious. Final inspection should therefore examine the perimeter under suitable light and verify that later decoration has not blocked movement or opened gaps.

Worked example 34.17. Decorative trim bridge

Two independent glazing frames are correctly installed with an isolated cavity; an interior-finish subcontractor later adds a continuous metal trim screwed through both frames; the follow-up inspection identifies the bridge; the trim is replaced with separated components attached to one frame each, preserving the intended decoupling.

34.18 Penetrations, sleeves, conduits and cable pathways

Every penetration is a local redesign of the boundary. Its surveillance record should identify purpose, location, size, sleeve, annular space, penetrating item, insulation, firestop or seal system, acoustic treatment, movement, support, spare capacity and approved detail. The penetration register should be opened before installation, not reconstructed from ceiling-space photographs at closeout.

Sleeves should be inspected for material, diameter, length, position and separation from other services. Oversized sleeves may create large annular spaces that exceed a listed system. Undersized sleeves can force tight rigid contact or prevent future sealing. Back-to-back boxes, continuous conduit, unlined ducts and cable bundles can provide paths even when the visible perimeter is sealed. The observer should therefore examine the complete route, not only the surface bead.[472]

Penetrating services should be independently supported where required; a pipe or conduit bearing on both sides of a separated wall can transmit vibration and damage sealant as it moves; cable trays should not be used as structural bridges through a barrier. Flexible connections, offsets, lined boxes or other treatments must match the approved design; spare sleeves should be capped and recorded, because an empty unsealed pathway can be a severe leak.

The project should prohibit unregistered field penetrations. Where urgent work is necessary, a temporary controlled opening procedure should assign approval, protection, observation and permanent closure. An electrician drilling an apparently harmless 25 mm hole after commissioning can alter both acoustic and security conditions.

34.18.1 Penetration path classification and inspection geometry

Each penetration should be classified by the path it creates, not only by the service it carries; a cable sleeve can provide a direct airborne opening, a rigid structural bridge, a flanking route through a shared enclosure, or a maintenance pathway that will be reopened repeatedly. The inspection record should therefore capture boundary type, opening shape, sleeve material, sleeve termination, annular geometry, fill depth, backing, movement allowance, service support, separation from other services and accessibility after completion; where the treatment depends upon a listed or

472 MB-1072. National Protective Security Authority, Secure Rooms, public guidance current at source freeze. Status at the 14 August 2026 source freeze: Current public guidance. Public locator: Use is confined to the source scope. The document does not.

tested system, the record should map the observed geometry to the permitted range rather than merely naming a product.

Geometry should be measured before sealant, firestop or escutcheons conceal the opening; at irregular penetrations, photographs from one direction can understate voids behind bundles or beneath pipes; the observer should obtain opposing or oblique views, use a scale, and record inaccessible sectors. Cable fill should be considered as both present construction and future change capacity; an oversized sleeve that appears convenient during construction can invite later uncontrolled additions. A completely packed sleeve can encourage technicians to drill an adjacent opening. The best record therefore shows the initial configuration, permitted spare capacity, closure method and change-control trigger. This turns the penetration from an anonymous hole into a managed boundary asset.

Worked example 34.18. Oversized sleeve

A 100 mm conduit is installed through a 200 mm sleeve, while the approved firestop and acoustic detail covers a much smaller annular space. The penetration is not sealed by simply adding more compound. The design team issues an approved revised system with backing, movement and support provisions, and the register records the disposition.

34.19 Firestop and acoustic-seal coordination

Fire-resistive and acoustic requirements frequently occupy the same joint or penetration, but the materials and geometries are not automatically interchangeable. A product marketed as an acoustical sealant may not form part of a listed firestop system. A rigid firestop mortar may satisfy a fire requirement yet bridge a resilient assembly or transmit vibration. The project must begin with an integrated detail and inspect the installed work against both evidence sets.[473][474]

ASTM E2174-24 and ASTM E2393-24 provide procedures for on-site inspection of installed firestop and fire-resistive joint systems. They are valuable models for qualified inspection, comparison with inspection documents, sampling and reporting. They do not establish acoustic performance criteria. ASTM C919-24 addresses acoustical sealant use within its scope. The surveillance programme should preserve these distinctions while coordinating the work so that one trade does not destroy the other's function.[475][476]

The inspector should verify system identity, substrates, opening dimensions, penetrating items, backing, depth, annular space, movement, adhesion, surface preparation and labels. Engineering judgments or field-evaluated systems should be specifically identified and retained. Recent ASTM guides and practices on firestop information and on-site identification can support this record, but the authority having jurisdiction and project-approved documents remain decisive.[477]

Sequence is critical. Acoustic backing may need to be installed before firestop, or a tested system may require a particular order. Finishes should not obscure labels or prevent later inspection. Where destructive verification

473 MB-1070. National Protective Security Authority, Protective Security Considerations, public guidance current at source freeze. Status at the 14 August 2026 source freeze: Current public guidance. Public locator: Use is confined to the source scope.
474 MB-1303. UK Government, Government Functional Standard GovS 007: Security, public edition current at source freeze. Status at the 14 August 2026 source freeze: Current public standard. Public locator: Use is confined to the source scope. The documen.
475 MB-0445. FCDO Services and UK National Authority for Counter-Eavesdropping, Secure Speech Environments.
476 MB-1025. National Cyber Security Centre, TEMPEST and electromagnetic security public information.
477 MB-0864. International Organization for Standardization, ISO 16283-1:2014, ISO 3382-2:2008.

is used, the sampled location should be repaired under controlled observation and linked to the original system.

Worked example 34.19. Firestop accepted, acoustic path remains

A cable penetration contains an approved firestop system and passes the code inspection; the conduit itself runs continuously between rooms without an approved internal treatment, creating an acoustic path; the acoustic surveillance record remains open; the conduit route is modified and treated according to the approved design without disturbing the compliant firestop perimeter.

34.20 HVAC ducts, silencers, flexible connections and breakout paths

Mechanical systems cross boundaries with large openings and operate under changing pressure and airflow. Surveillance should verify duct size, gauge, lining, silencer model, length, orientation, splitters, access doors, flexible connections, supports, transitions, seal continuity and clearance from surrounding construction. A silencer installed backwards, short-circuited by an unlined bypass, compressed at a transition or connected rigidly across an isolated wall can defeat the design even when its model number is correct.[478]

Duct penetrations should be observed before closure from both sides where possible; the wall or slab opening, sleeve, annular treatment, fire damper, smoke damper, access requirement and acoustic treatment must coexist; a damper frame or sleeve can create a rigid bridge. Access doors may introduce a weak panel; the observer should confirm that fire and

478 MB-0231. ASTM International, ASTM E2638-24.

maintenance requirements have not forced an undocumented acoustic compromise.

Breakout and break-in paths require attention beyond the penetration. A duct may carry speech through the wall, radiate through thin sheet metal into an adjoining space, and receive sound again downstream. Silencer evidence under ASTM E477-26 concerns laboratory acoustical and airflow performance within its scope. Field surveillance must verify that the installed device, airflow direction and connecting geometry correspond to that evidence.[479]

Operating-state checks should occur after systems are energised. Flexible connections may pull tight. Vibration isolators may bottom out. Ducts may contact ceilings or partitions. Dampers may change the acoustic path between normal, purge, fire and night modes. The final record should identify which mechanical states were observed and which require commissioning tests.

Worked example 34.20. Silencer bypass

A correctly identified silencer is installed in the main supply duct; a small pressure-relief branch, added during balancing, bypasses the silencer and reconnects downstream; the branch is acoustically significant despite its modest size; surveillance detects it before ceiling closure, and the mechanical design is revised to preserve both airflow and isolation.

34.21 Floors, ceilings, plenums and raised-floor barriers

A secure boundary should be traced in three dimensions; walls that terminate at a suspended ceiling can be bypassed through a common

479 MB-0445. FCDO Services and UK National Authority for Counter-Eavesdropping, Secure Speech Environments.

plenum; raised floors can connect rooms beneath partitions; structural slabs can transmit vibration around lightweight barriers. Roof decks, soffits, access panels, luminaires and ceiling supports can interrupt continuity or create rigid bridges. Surveillance should therefore follow the boundary from structural floor to structural soffit or to the approved alternative enclosure, recording every transition.

Ceiling-space inspection should occur before services and tiles make access difficult; the observer should verify above-ceiling barriers, wall-head continuity, deck-flute closures, ceiling hangers, seismic bracing, light fittings, loudspeakers, diffusers, access panels and service crossings; a ceiling tile rating does not establish room-to-room isolation where the plenum is shared. Where an independently suspended acoustic ceiling forms part of the design, hangers, perimeter isolation and penetrations should be inspected under load.

Raised-floor barriers require coordination with pedestals, stringers, cable trays, floor boxes and air-distribution paths; the barrier should remain continuous behind equipment and beneath doors where required; removable panels may be necessary for inspection, but their joints and fasteners must not create an unrecorded weak path. The penetration register should include underfloor services rather than treating them as invisible infrastructure.

Floor finishes can alter thresholds and perimeter joints. A late carpet, stone or resilient-flooring change may prevent an automatic door bottom from contacting the threshold or may bridge an isolation joint. Follow-up surveillance should therefore occur after finish installation and before final doorset adjustment.

Worked example 34.21. Plenum route concealed by complete walls

Two room partitions extend only to a common suspended ceiling, while an above-ceiling barrier was shown on a separate detail. The wall inspection passes, but the plenum inspection finds that cable trays have interrupted the barrier in three places. Those openings are reconstructed and registered before ceiling tiles are installed.

34.22 Audiovisual systems, controls, sensors and equipment supports

Audiovisual and control systems are prolific creators of late penetrations; displays, loudspeakers, microphones, cameras, occupancy sensors, thermostats, card readers, power supplies and conferencing equipment require cables, boxes and supports that may not be finalised when the acoustic boundary is built. Surveillance should link each device to an approved pathway, mounting detail and penetration identifier; “low voltage” does not mean low acoustic consequence.

Recessed equipment can reduce mass and leave thin back-to-back paths. Surface-mounted systems can introduce rigid brackets or cable raceways crossing isolated elements. Powered door hardware can alter frames and seals. Ceiling loudspeakers and microphones can connect to shared plenums. The observer should verify backboxes, lining, spacing, conduit treatment, cable seals, support independence and equipment clearances before devices conceal the openings.[480]

Firmware and network configuration are not the principal subject of this chapter, but the physical installation record should identify networked

480 MB-1025. National Cyber Security Centre, TEMPEST and electromagnetic security public information.

devices and accessible maintenance routes because later replacement can disturb the boundary. The as-built baseline should show device location, model, pathway and service access. Where cameras or microphones are prohibited or specially controlled, security personnel must verify that the installed inventory matches the authorised design.

Equipment supports should not bridge isolated construction. A display bracket bolted through both leaves, a cable tray hung from a floating ceiling and structure, or a floor-mounted cabinet spanning an isolation joint can transmit vibration. The inspection should examine load paths, not merely mounting strength.

Worked example 34.22. Display bracket as a structural bridge

A large display is installed on an isolated inner leaf using long anchors that penetrate to the structural wall behind it. The mount is safe but acoustically defeats the decoupling. The installation is redesigned with an approved independent support frame, and the repair is inspected before finishes are restored.

34.23 Photographic evidence architecture

Construction photographs should be designed as records, not accumulated as souvenirs. A useful image set answers where the condition is located, what requirement governs it, what is visible, how scale and orientation are established, when it was captured, who captured it, which device and file produced it, and how it entered the controlled repository. UFGS 01 32 33.00 10 provides a current public framework for planned photographic documentation, while secure projects require tighter device, transfer and distribution controls.[481]

Each inspection unit should contain three image levels; the context image locates the work within the room and grid; the relationship image shows the assembly or interface; the detail image reveals the measured feature, label or defect. A scale should be placed in the same plane as the measured condition when dimensional interpretation matters. The record should avoid digital zoom that obscures resolution and should preserve the original file rather than only a compressed report image.

Coverage can be screened with a weighted evidence-completeness index:

$$E_c = \frac{\sum_{i=1}^{k} w_i x_i}{\sum_{i=1}^{k} w_i}$$

where E_c is the dimensionless completeness index, w_i is the assigned importance weight for evidence class i, x_i is the completion state of that class between 0 and 1, and k is the number of evidence classes. A project might assign greater weight to location, requirement linkage and original-file preservation than to decorative caption style. The index is a management screen. It does not prove authenticity or conformity.[482]

Table 34-5. Photographic evidence fields

Field	Minimum record	Reason
Image ID	Unique immutable identifier	Prevents ambiguous references

481 MB-1303. UK Government, Government Functional Standard GovS 007: Security, public edition current at source freeze. Status at the 14 August 2026 source freeze: Current public standard. Public locator: Use is confined to the source scope. The documen.
482 MB-1024. National Cyber Security Centre, Public technical-security policy and guidance resources.

Field	Minimum record	Reason
Location	Facility, floor, room, grid, elevation and viewpoint	Reconstructs physical position
Subject	Assembly, layer, penetration, defect or repair	Defines the observed proposition
Requirement link	Drawing, detail, specification and requirement ID	Establishes comparison basis
Capture data	Date, time, author, approved device and file name	Supports provenance
Orientation	Direction, context image and marked plan	Prevents reversed interpretation
Scale	Ruler, gauge or known dimension in same plane	Supports dimensional inference
Original file	Native file retained without editing	Preserves primary image data
Derivative status	Crop, annotation or redaction recorded separately	Distinguishes interpretation from source
Custody and integrity	Transfer log, repository, access and hash manifest	Detects later change and tracks handling

34.23.1 Image sequence, viewpoint control and independent reconstruction

A high-assurance image set should follow a repeatable sequence; the first image establishes the room or work area; the second locates the boundary segment against grid, elevation or a durable identifier; the third shows the complete inspection unit. Subsequent images record details, dimensions, product labels and defects. A final image confirms the condition immediately before closure. Viewpoint identifiers should be stable enough that a later reviewer can compare opposite faces, successive layers and repaired conditions without guessing where the camera stood.

The evidence package should be tested by independent reconstruction before the work disappears. A reviewer who did not attend the inspection should be asked to identify the room, boundary, orientation, assembly layer, requirement, observed condition and disposition from the images and index alone. Failure to reconstruct reveals deficiencies while supplemental images can still be taken. The exercise also detects misleading close-ups that show a technically correct detail but omit an adjacent bridge or discontinuity. Photographic completeness is therefore not measured by file count or resolution. It is measured by whether the controlled set allows a competent person to understand what was observed, where it existed, when it existed, and how the observation supports the stated conclusion.[483]

Worked example 34.23. Photograph without location

A report contains a sharp close-up of a correctly sealed conduit but no room, grid or orientation. Six identical conduits exist. The image cannot close any specific register item. The revised procedure requires a room placard in the context image, a marked plan reference and the penetration ID visible in the detail sequence.

34.24 Image metadata, indexing and security control

Metadata should be preserved deliberately rather than trusted blindly. Camera time can be wrong, location services can be disabled, and editing software can rewrite fields. The project should record approved device identifiers, synchronise time sources, preserve original files, and generate a separate index that is itself controlled. Embedded metadata is corroborating evidence. It is not infallible testimony.

File naming should be stable, machine-readable and independent of personal memory; a name might encode project, room, inspection unit, image sequence and original-file status, while the repository stores richer

483 MB-1072. National Protective Security Authority, Secure Rooms, public guidance current at source freeze. Status at the 14 August 2026 source freeze: Current public guidance. Public locator: Use is confined to the source scope. The document does not.

metadata; names should not reveal sensitive details where files may appear outside the controlled environment. The index should permit search by room, date, system, requirement, penetration, door, nonconformance and photographer.

Security controls should address capture, temporary storage, transfer, repository access, export, redaction, backup, retention and destruction. Personal phones and consumer cloud synchronisation may be unacceptable. Where a controlled camera lacks network capability, a documented transfer station can import files, preserve originals and generate integrity digests. Where authorised mobile devices are used, automatic upload destinations and cached copies should be examined.[484]

Annotations should be made on derivatives. Arrows, boxes and captions can improve comprehension but alter pixel content. The original file should remain unchanged, linked to the derivative through the image index. Redaction should be performed on a separate copy under an authorised process, with the reason and scope recorded. A black rectangle placed over an image may conceal visible content while leaving recoverable metadata or underlying layers in some file types, so the project should use suitable tools and verification.[485]

Worked example 34.24. Cloud-synchronised camera roll

An authorised inspector uses a tablet whose default settings copy every image to a personal cloud account. The security review detects the configuration before site use. Synchronisation is disabled, a controlled

484 MB-1070. National Protective Security Authority, Protective Security Considerations, public guidance current at source freeze. Status at the 14 August 2026 source freeze: Current public guidance. Public locator: Use is confined to the source scope.
485 MB-0864. International Organization for Standardization, ISO 16283-1:2014, ISO 3382-2:2008.

application profile is installed, and a test image is traced through capture, transfer, repository ingestion and deletion from the device.

34.25 Penetration registers as live configuration records

The penetration register should begin during design and remain active through operation. Each entry should have a unique identifier, location, boundary, service, opening geometry, sleeve, penetrating item, approved system, responsible trade, inspection status, photographs, nonconformance history, closeout state and later change record. The identifier should appear physically near the penetration where permitted and in drawings, photographs, inspection forms and commissioning records.

A register is more than a list of holes; it is a relational map between physical openings and evidence; one penetration may contain several services and several inspection events; a service route may cross multiple boundaries. The data structure should allow these relationships without forcing users to write free-text narratives for every query. Stable identifiers are essential because room names and drawing numbers can change.

The register should reconcile planned, installed and removed penetrations; planned openings that were never used should be closed and documented; field openings should be added before work begins; abandoned services should not simply be cut flush and forgotten. Their sleeves, residual conduits and seals remain part of the boundary. A final count that merely compares total planned and total installed can conceal substitutions between locations.

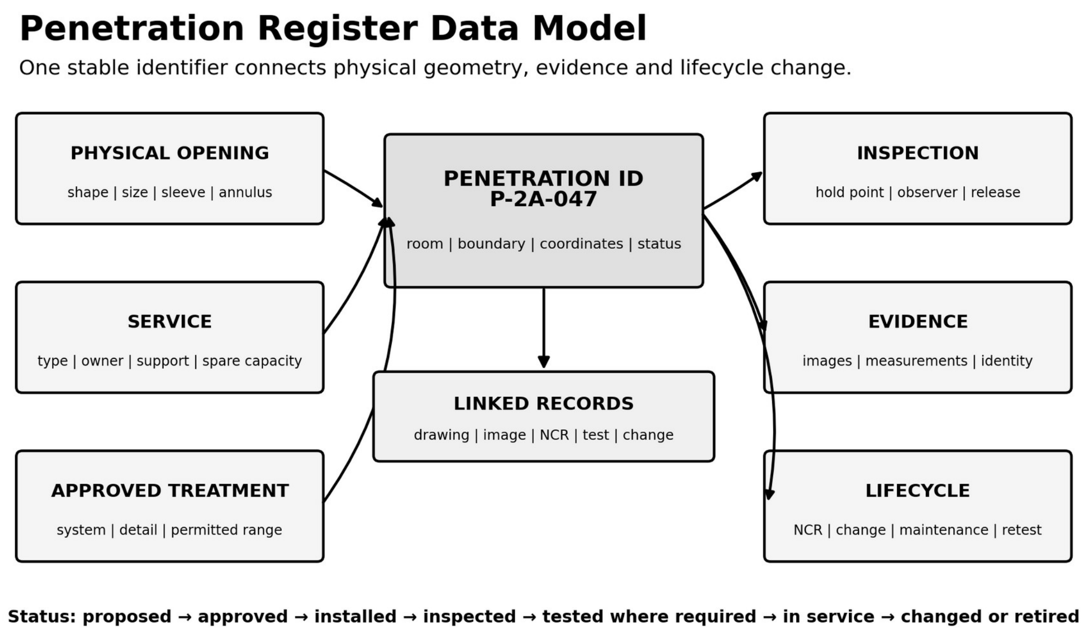

Figure 34-5. The penetration-register data model links physical opening, service, approved system, inspections, images, nonconformances and lifecycle changes. Author's original diagram.

Table 34-6. Penetration-register minimum schema

Data group	Key fields	Lifecycle use
Identity	Penetration ID, asset ID and status	Stable reference
Location	Room, boundary, grid, elevation and coordinates	Physical recovery
Geometry	Opening, sleeve and annular dimensions	System selection and inspection
Service	Type, quantity, size, material and route	Path analysis
Approved treatment	Detail, listed system, acoustic provision and revision	Conformity basis
Installation	Trade, date, product, batch and installer	Provenance
Inspection	Hold point, inspector, result and release	Concealed-work proof
Images	Context, relationship, detail and repair IDs	Visual evidence
Nonconformance	NCR, disposition, correction and retest	Departure history

Data group	Key fields	Lifecycle use
Operations	Access, maintenance, later change and closure	Configuration control

Worked example 34.25. Register reconciliation

The design register contains 46 penetrations. Site records contain 49 installed IDs, two planned openings were omitted, and five unplanned openings were added. The project does not accept a net difference of three. Each planned and installed identifier is reconciled individually, the omitted openings are confirmed closed, and the five additions receive complete approval and inspection records.

34.26 Door and seal schedules as maintenance baselines

The door and seal schedule should connect each doorset to its leaf, frame, hardware, glazing, perimeter seals, meeting-stile seals, automatic bottom, threshold, control system, inspection history, acoustic test and maintenance requirements. Door numbers alone are insufficient where leaves or hardware are replaced. Serial numbers, model designations and approved-submittal references should be retained for components whose identity affects performance.

The schedule should record critical adjustment parameters; these may include frame clearances, latch engagement, closer sweep and latch speeds, opening force, automatic-bottom drop, seal contact and threshold condition; the chapter does not impose universal values; it requires the project to preserve the values established by the approved system, accessibility requirements, fire listing, manufacturer and commissioning plan.

Seal condition should be recorded as a continuous perimeter, not a single pass/fail box; a schematic can divide the head, hinge jamb, latch jamb, threshold and meeting stile into segments; defects should be located and photographed. This allows maintenance staff to compare later wear with the handover baseline and to replace compatible components rather than installing an apparently similar weather seal.

Table 34-7. Door and seal schedule fields

Category	Required data	Why it matters
Doorset identity	Door ID, room, leaf and frame serial or model	Prevents component confusion
Construction	Leaf core, thickness, frame type, glazing	Links to approved evidence
Hardware	Hinges, latch, closer, lock, power transfer	Controls alignment and penetrations
Seals	Head, jamb, meeting stile, bottom and threshold models	Preserves contact system
Installation	Anchors, shims, perimeter treatment and date	Supports concealed-work record
Adjustment	Clearances, contact, forces and operating state	Establishes baseline
Test	Method, date, result, uncertainty and report	Links observed performance
Maintenance	Inspection interval, cleaning, adjustment and replacement criteria	Preserves lifecycle validity
Change history	Component replacement, reason, approval and retest	Controls drift

Worked example 34.26. Seal replacement without identity

A damaged jamb seal is replaced during routine maintenance with a visually similar extrusion from local stock. The schedule shows that the original seal had a different bulb geometry and compression range. The unapproved replacement is removed, the correct component is fitted, and the doorset is readjusted and checked against its baseline.

34.27 Field observations, daily reports and trend analysis

Field observation reports should separate fact, interpretation, instruction and disposition; the factual record states the location, time, persons present, documents reviewed, conditions observed, measurements and photographs; technical interpretation explains why the condition matters; contractual direction should be issued by the authorised party. Final disposition belongs in the nonconformance or decision record. Combining all four in casual prose can create uncertainty about whether a correction was ordered, suggested or merely discussed.

Daily reports should record work packages active, hold points called, inspections completed, releases issued, conditions not observed, materials received, weather or environmental limits, security incidents, nonconformances, corrective work and photographs. The report should also identify areas closed without inspection and the reason. Silence should never be interpreted as a pass.

Trend analysis can reveal process deterioration before final testing. Let

$$r_d = \frac{D}{U}$$

where r_d is the observed defect rate for a defined period and defect class, D is the number of detected defects, and U is the number of comparable inspected units. The rate is dimensionless. It is not an estimate of the true project defect rate unless the units and sampling are representative. Used consistently, however, it can show whether a new crew, material lot, shift or detail is associated with a rising number of departures.[486]

486 MB-0885. International Organization for Standardization, ISO 19650-5:2020.

Reports should use controlled vocabulary without erasing useful narrative; structured fields support analysis, while concise observations capture context; photographs, sketches and marked plans should be linked rather than pasted without identifiers; the observer should sign or authenticate the report and the repository should preserve revision history.

Worked example 34.27. Rising defect trend

During the first week, two perimeter-seal defects are found in 40 inspected wall bays; during the second week, nine are found in 35 bays after a new crew begins; the project does not wait for a room test. It pauses the affected activity, reviews training and substrate preparation, expands inspection of the second-week population and verifies the correction on a renewed first-of-type unit.

34.28 Nonconformance identification and classification

A nonconformance is a failure to fulfil a requirement. It should be recorded when observed, not after the parties agree on blame or remedy. The report should identify the requirement, actual condition, location, extent, evidence, immediate containment and person notified. Early recording preserves facts while the work remains visible and prevents a disputed memory from replacing the contemporaneous record.[487]

Classification should reflect consequence and urgency. A critical nonconformance threatens the protected boundary, life safety, structural integrity, controlled information or ability to verify concealed work; a major nonconformance materially departs from an approved configuration or can affect performance; a minor nonconformance is limited, visible and readily

487 MB-1025. National Cyber Security Centre, TEMPEST and electromagnetic security public information.

correctable without affecting the controlling mechanism. An observation may indicate a risk or incomplete record without yet proving nonconformity; classification should not be manipulated to avoid escalation.

The project should distinguish defect, nonconformance and failure; a visible installation flaw is a defect; it becomes a nonconformance when compared with a requirement; a failed acoustic test is a performance failure, but it may have several underlying nonconformances or none yet identified. This vocabulary supports causal investigation rather than assuming that the first visible flaw caused the measured result.

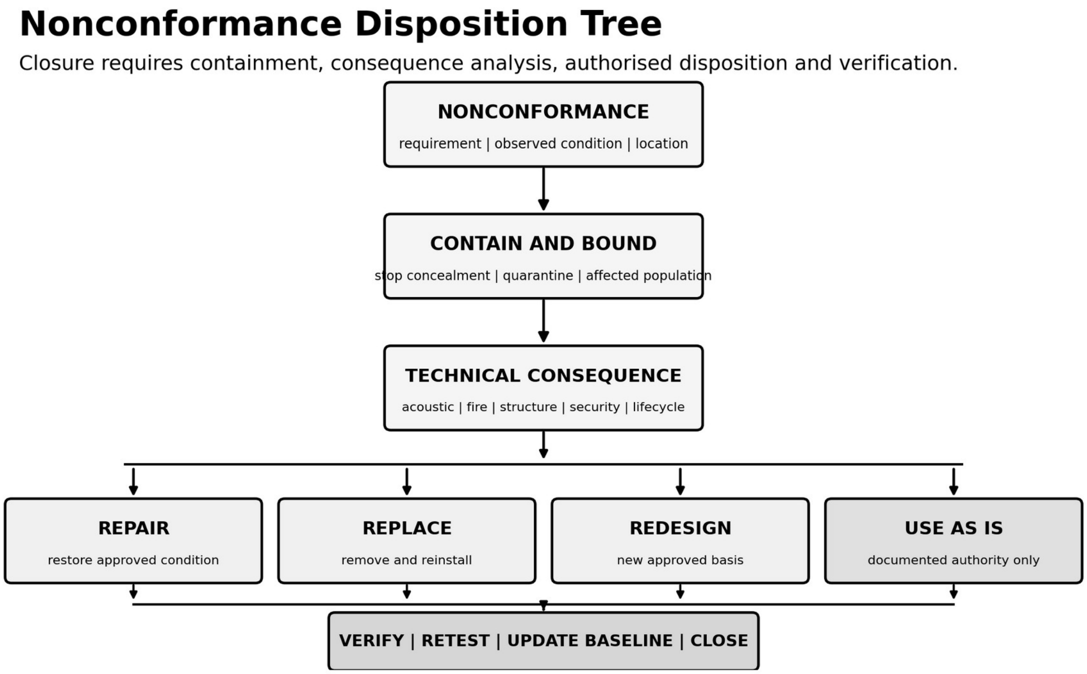

Figure 34-6. The nonconformance disposition tree separates containment, consequence analysis, authorised disposition, corrective execution, verification and closure. Author's original diagram.

Table 34-8. Nonconformance classification and response

Class	Typical condition	Immediate action	Closure authority
Critical	Concealed boundary opened, uncontrolled bridge, life-safety conflict, lost evidence	Stop affected work, secure area, preserve evidence, escalate	Named senior technical and authority roles
Major	Wrong assembly component, repeated seal defect, unapproved penetration	Contain population, analyse consequence, approve correction	Assigned designer or specialist with owner review
Minor	Local visible workmanship departure with no concealed consequence	Correct promptly and verify	Quality-control role within delegated limit
Observation	Potential issue, ambiguous requirement or incomplete record	Clarify, monitor or raise information request	Relevant reviewer
Systemic	Recurring defect across crews, lots or rooms	Suspend process, expand sample, investigate cause	Project quality leadership and technical authority

34.28.1 Bounding the affected population

When a nonconformance is discovered, the project should bound the potentially affected population before treating the observed item as isolated; the inquiry should identify the first and last units produced under the same crew, method, detail, material lot, tool setting, shift, supervisor and inspection regime. It should also examine whether the defect could arise from a common upstream cause, such as an ambiguous drawing, incorrect template, purchasing substitution or training omission; the affected population may therefore cross rooms, trades or dates that appear unrelated in the ordinary progress schedule.

Bounding should be conservative but evidence-led. It should not condemn every similar assembly merely because one defect exists, nor should it stop at the photographed location because further inquiry is inconvenient; records from preparatory meetings, delivery logs, daily reports, work packs, photographs and prior inspections can narrow the range. Representative openings or tests may then refine it; the nonconformance report should state the provisional population, the evidence used, the expansion or reduction rule, and the final disposition of every unit; this practice prevents a local repair from concealing a systemic process failure and provides a rational basis for estimating rework, schedule exposure and residual uncertainty.

Worked example 34.28. Misclassified repeated defect

Three isolated seal voids are initially logged as minor; over two days, the same void pattern appears in twelve rooms and two crews; the condition is reclassified as systemic; work stops, the affected population is contained, and the project investigates material, tooling, training and substrate preparation rather than repairing only the visible spots.

34.29 Causal analysis and recurrence control

Correcting the observed defect is not always sufficient; a recurring bridge, void or mislabelled product indicates a process cause that may have affected uninspected work; causal analysis should ask how the condition arose, why existing controls did not prevent it, why inspection did or did not detect it, and what evidence defines the affected population. The aim is not to produce a decorative fishbone diagram; it is to select controls that make recurrence less likely and improve detection if recurrence occurs.

Cause categories may include ambiguous design, incomplete submittal, procurement substitution, storage damage, sequence conflict, inadequate training, unsuitable tools, access restriction, schedule pressure, supervision failure, inspection timing, data-entry error or security constraint. Several causes can interact. A seal void may reflect dirty substrate, rushed work and a hold point called after partial closure. Blaming the installer alone would leave the system unchanged.

Corrective action addresses the detected nonconformance and its cause. Preventive or risk-reduction action addresses similar potential failures elsewhere. ISO 9001:2015 with Amendment 1:2024 provides a process framework for nonconformity and corrective action, while ISO 19011:2026 supports evidence-based auditing. The chapter uses these principles without turning the construction project into a certification exercise.[488][489]

488 MB-1303. UK Government, Government Functional Standard GovS 007: Security, public edition current at source freeze. Status at the 14 August 2026 source freeze: Current public standard. Public locator: Use is confined to the source scope. The documen.
489 MB-1024. National Cyber Security Centre, Public technical-security policy and guidance resources.

Recurrence control should be verified. Revised training, a new checklist or an additional inspector is not effective merely because it was announced. The project should examine subsequent units, compare defect trends and confirm that the new control operates. Where the cause involves design or product identity, the approved baseline and submittal register should be revised.

Worked example 34.29. The wrong corrective action

Repeated rigid bridges are found where electricians strap conduit to both leaves; the initial response removes the straps in visible locations; causal analysis shows that the electrical detail lacks an independent support method; the design is revised, the crew is trained on the new support, earlier rooms are inspected, and follow-up samples confirm that the bridge pattern has stopped.

34.30 Repair, replacement, redesign and use-as-is dispositions

Every nonconformance requires an authorised disposition. The principal routes are repair, replacement, redesign, rework to the original requirement, or acceptance as-is under a documented technical and authority decision. The chosen route should address the physical mechanism, fire and structural interfaces, appearance, maintainability, evidence and need for retesting. A repair that restores mass but creates a rigid bridge is not a successful acoustic disposition.

Repair methods should be approved before execution where the condition is consequential; the method should identify preparation, materials, sequence, access, inspection stages and final evidence; a representative repair mock-up may be warranted when many units are affected or when the repair differs materially from the tested assembly. Replacement is preferable where identity, damage or reliability cannot be established; redesign may be necessary when the field condition cannot accommodate the original detail.

Use-as-is is the most easily abused disposition; it should require a reasoned consequence analysis, identification of affected requirements, supporting calculations or tests, residual risk, limits of use, authority and lifecycle implications; cost or schedule alone is not a technical justification. A designer's acceptance may resolve a contractual design issue but does not automatically satisfy the competent security authority or authority having jurisdiction.

Temporary dispositions should have expiry dates and physical controls. A temporary sealed opening, protective enclosure or operational restriction may permit work to continue, but the final repair and verification must remain visible in the issue register. Temporary conditions that disappear from meeting minutes have a habit of becoming permanent vulnerabilities.

Worked example 34.30. Use-as-is rejected

A door frame contains two fewer anchors than the approved shop drawing. The contractor proposes acceptance because the frame feels rigid. Analysis shows that the missing anchors can affect alignment under the heavy leaf and future seal contact. The disposition requires controlled installation of approved supplemental anchors, followed by frame measurement, door adjustment and documented contact checks.

34.31 Corrective-action verification, retesting and closure

A nonconformance is not closed when work is said to be complete; closure requires evidence that the authorised disposition was executed, the physical condition now conforms or is otherwise accepted under the approved decision, affected records were revised, and any required retesting supports the stated conclusion. The verifier should be competent for the corrected feature and sufficiently independent for the consequence; the person who performed the repair may document it, but should not always be the sole person declaring success.

Verification should repeat the relevant observation under conditions that expose the controlling mechanism; a repaired seal should be examined for preparation, backing, depth, adhesion and continuity, not merely photographed after tooling; a corrected resilient bridge should be checked for clearances under expected load. A door repair should include full operating and latch cycles; a penetration repair should reconcile the installed system, register and fire-acoustic requirements. Where the original evidence was lost through concealment, the project should state what the new evidence can and cannot establish.

Retesting is required when the departure or repair can materially affect measured performance, when the contract or authority requires it, or when inspection alone cannot demonstrate the outcome. The test method, operating state, instrumentation, calibration, background, uncertainty and decision rule should be defined. A pass obtained under a more favourable state than the original requirement does not close the issue. ASTM and ISO field acoustic methods, ISO 12999-1, JCGM 106 and ILAC G8 provide the necessary metrological discipline within their respective scopes.[490][491][492]

A closure-time screen can be expressed as:

$$t_c = t_v - t_o$$

where t_c is the elapsed closure duration, t_o is the time the nonconformance was opened, and t_v is the time final verification was accepted. All times must use a consistent time basis. The interval does not measure quality by itself. It is useful for identifying ageing critical issues, bottlenecks and defects being administratively deferred.

Table 34-9. Corrective-action closure dossier

Closure element	Required evidence	Closure question
Original condition	Requirement, observation, images and extent	What failed?
Containment	Work stopped, population bounded, temporary protection	Was propagation controlled?
Consequence analysis	Acoustic, fire, structural, security and lifecycle effects	Why does it matter?
Disposition	Approved repair, replacement, redesign or use-as-is decision	What was authorised?
Corrective execution	Materials, sequence, personnel, dates and images	What was done?
Verification	Independent observation, measurements and record review	Was the disposition executed correctly?
Retest	Method, state, raw data, uncertainty and decision	Does performance evidence support closure?
Register revision	Drawings, penetration, door, material and issue registers	Is the baseline coherent?

490 MB-0796. International Electrotechnical Commission, IEC 60268-16:2020.
491 MB-1070. National Protective Security Authority, Protective Security Considerations, public guidance current at source freeze. Status at the 14 August 2026 source freeze: Current public guidance. Public locator: Use is confined to the source scope.
492 MB-1303. UK Government, Government Functional Standard GovS 007: Security, public edition current at source freeze. Status at the 14 August 2026 source freeze: Current public standard. Public locator: Use is confined to the source scope. The documen.

Closure element	Required evidence	Closure question
Authority status	Contractual, code and security decisions separated	Who accepted what?
Recurrence control	Cause, process change and follow-up evidence	Will the problem repeat?

34.31.1 Retest decision matrix and comparability

A retest decision should consider mechanism, repair scope, detectability and consequence; local visual correction may be sufficient when the defect and repair are completely observable and no performance mechanism remains uncertain; retesting becomes stronger when the repair changes a door seal, penetration, silencer connection, resilient junction or other element that can control system performance. It is also warranted when the original failure was detected by measurement, when the affected population is broad, or when the authority's acceptance basis expressly requires a new result; the decision and its rationale should be recorded before testing so that a favourable outcome does not retrospectively define the rule.

Before-and-after results are comparable only when method, instrument chain, source, receiver positions, room condition, background, reverberation, operating state and data treatment are sufficiently consistent. Where they differ, the report should quantify or explain the effect rather than presenting a simple numerical improvement. Laboratory or field testing should be performed by competent personnel using calibrated equipment and an applicable method, with uncertainty and decision rules disclosed.[493][494][495][496] A retest can demonstrate defined post-repair performance. It cannot prove that every concealed repair detail matches the

493 MB-0885. International Organization for Standardization, ISO 19650-5:2020.
494 MB-0961. James M. Atkinson, Acoustic Security Engineering for Secure Rooms, Revision 1.2C2.
495 MB-0445. FCDO Services and UK National Authority for Counter-Eavesdropping, Secure Speech Environments.
496 MB-1025. National Cyber Security Centre, TEMPEST and electromagnetic security public information.

approved construction unless the inspection evidence also supports that proposition.

Worked example 34.31. Repair complete, issue still open

A wall penetration is resealed and photographed; the image shows a neat finished surface, but the approved repair required backing depth verification before final sealant; no concealed-stage evidence exists, and the affected room has not been retested. The record remains open. A controlled verification opening confirms the backing, the sample is repaired under observation, and targeted acoustic testing completes the dossier.

34.32 Missed hold points and concealed-condition recovery

A missed hold point is an evidentiary nonconformance even when the concealed work may be physically correct; the project has lost the planned opportunity to compare the installed condition with the approved basis; the response should therefore address both physical risk and proof deficit. Simply asking the installer to sign a retrospective statement is seldom equivalent to direct observation, especially where the statement is broad, unsupported or prepared after a dispute.

Recovery options include selective opening, borescope inspection, non-destructive imaging, material records, contemporaneous progress photographs, witness statements, quantity reconciliation, targeted performance testing and expanded inspection of comparable work. Each method has limits. A borescope can show a small cavity but may miss distributed bridges. A thermal or air-leakage method may locate some discontinuities but cannot prove board-layer identity. An acoustic test can demonstrate a room-pair result under a defined state, but cannot show that every concealed firestop or fastener complies. The recovery plan should combine methods according to the proposition.[497]

The project should determine why the point was missed; late notice, unclear responsibility, schedule pressure, access denial, incorrect register status and inspector absence imply different corrective actions; if the contractor closed work without required release, the contract may allocate opening and delay costs. If the reviewer failed to attend after proper notice and the contract permitted continuation, the remedy may rely on the defined substitute evidence; the chapter does not decide contractual liability. It requires the factual and technical record needed for that decision.

Recovery should be proportionate but not complacent; opening one location may be sufficient when the population is demonstrably uniform and supporting evidence is strong; repeated missed points or inconsistent work may require a broader destructive sample; any repaired openings become new controlled work and require their own inspection and records.

Worked example 34.32. Retrospective declaration rejected

A subcontractor closes 18 wall bays before inspection and submits a letter stating that all work followed the drawings. The project reviews delivery quantities, worker photographs and adjacent open bays, then selects six stratified openings at perimeters, services and wall fields. Two rigid bridges are found. The sample expands to the full affected population, and the missed-point process triggers a root-cause review.

497 MB-0864. International Organization for Standardization, ISO 16283-1:2014, ISO 3382-2:2008.

34.33 As-built drawings and the configuration baseline

An as-built drawing should represent the installed condition supported by field evidence. It should not be a design sheet with the title block changed after construction. The as-built process reconciles approved design, shop drawings, information requests, substitutions, nonconformance dispositions, field dimensions, penetration and door registers, equipment schedules, photographs, test reports and change records. Conflicts are resolved before the baseline is issued.[498]

The baseline should distinguish spatial accuracy from evidentiary certainty. Some dimensions may be surveyed. Others may be derived from approved shop drawings and verified samples; concealed conditions may be supported by photographs and inspection forms; the record should identify the basis rather than presenting every line with equal confidence; where a critical route remains uncertain, the uncertainty should be carried into the lifecycle plan and not erased by drafting convention.

Configuration states should remain separate. “As-designed” records the intended solution. “As-submitted” records the contractor’s approved proposal. “As-installed” records the physical configuration observed. “As-tested” records the configuration and operating state during measurement; “as-authorised” records the conditions under which the competent authority permits use; a project can have a complete as-built drawing while an acoustic test issue remains open, or a passing test while a controlled-document requirement remains unresolved. The states converge only after deliberate reconciliation.

498 MB-0961. James M. Atkinson, Acoustic Security Engineering for Secure Rooms, Revision 1.2C2.

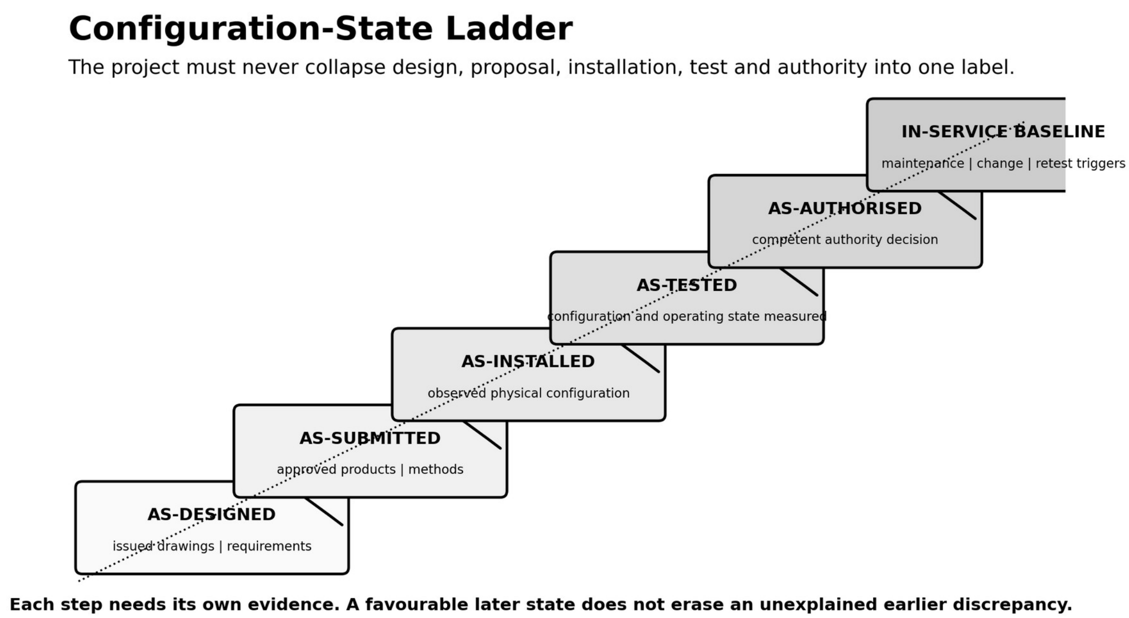

Figure 34-7. The configuration-state ladder preserves distinctions among as-designed, as-submitted, as-installed, as-tested and as-authorised evidence. Author's original diagram.

34.33.1 Baseline content and drawing confidence

The final baseline should show boundary extents, wall and floor constructions, structural junctions, doors, glazing, ceiling and plenum barriers, raised-floor barriers, ducts and silencers, penetrations, service routes, equipment supports, access panels, test locations and controlled change zones. It should reference schedules rather than duplicate volatile detail where appropriate. Stable IDs permit a drawing symbol to link to a full penetration or doorset record.

Drawing confidence can be classified by evidence basis, such as surveyed, directly observed, photographically verified, document-derived, inferred or unknown. Such classification is more honest than pretending that every concealed conduit was surveyed to millimetre accuracy. It also helps future investigators choose where to open construction or where a change may be made safely.

Worked example 34.33. As-built drawing conflicts with evidence

A final drawing shows a cable tray penetrating the north wall at grid 5; the penetration register and photographs place it at grid 6, while the test report identifies the grid 6 condition; the project does not select the most convenient record. It surveys the tray, corrects the drawing, links the evidence and records the reconciliation before baseline issue.

34.34 Evidence manifests, cryptographic hashes and chain of custody

Digital construction evidence should be preserved so that later users can detect alteration, reconstruct handling and distinguish original files from derivatives. A manifest should list each file's stable identifier, name, size, format, capture or creation time, repository path, source device or system, author, associated inspection unit and cryptographic digest. The manifest itself should be versioned and retained with the evidence package.[499]

Let

$$h_f = H(f)$$

where f is the exact byte sequence of a file, H is a specified cryptographic hash function, and h_f is the resulting digest. If the same algorithm applied later produces a different digest, the file content changed or the implementation failed. If the digest is unchanged, the inference is limited to byte-level equality under the algorithm. It does not prove that the photograph depicts the claimed wall, that the camera clock was correct, or that the observer was authorised. FIPS 180-4 specifies SHA-family

499 MB-1074. National Protective Security Authority, Secure Working Areas, public guidance current at source freeze. Status at the 14 August 2026 source freeze: Current public guidance. Public locator: Use is confined to the source scope. The document d.

algorithms used to generate such digests, while NISTIR 8387 and ISO/IEC 27037 provide broader preservation concepts.[500]

Chain of custody should record each transfer or controlled access event that matters to evidentiary reliability; the record identifies item, custodian, date and time, purpose, action, source, destination, integrity check and exceptions; automated repository logs can support this process, but they should be retained, time-synchronised and protected. A chain containing every routine read event may be impractical; the project should define the events needed to reconstruct custody and alteration risk.

Evidence should be backed up in accordance with authorised retention and security rules; encryption protects confidentiality but introduces key-management duties; file formats should remain accessible, with preservation copies and migration records where long asset lives are expected. Original proprietary files may be retained alongside durable derivatives; the record should avoid dependence on a vendor portal that may be unavailable after contract closeout.

34.34.1 Repository validation and manifest closure

Before handover, the repository should be validated as a controlled information set. The check should confirm that every manifest entry resolves to one file, every required file appears in the manifest, filenames and identifiers are unique, cryptographic digests reproduce, permissions match the distribution plan, and superseded files are segregated without destroying the audit trail. Links from drawings, penetration records, door

500 MB-1072. National Protective Security Authority, Secure Rooms, public guidance current at source freeze. Status at the 14 August 2026 source freeze: Current public guidance. Public locator: Use is confined to the source scope. The document does not.

schedules and nonconformance reports should resolve to the intended evidence. A file that exists but cannot be found through the project's indexes is practically absent during an urgent investigation.

Validation should also examine format longevity and authenticity dependencies. Proprietary viewers, expiring cloud links, personal accounts and embedded external references can make evidence unavailable after turnover. Originals should be preserved in their native form where appropriate, accompanied by durable derivative formats for routine access. The manifest should identify conversion, redaction or annotation so that a derivative is never mistaken for the original. Access logs and transfer receipts support custody, while hashes support byte-level change detection.[501] The final closure record should state the validation tools, date, operator, exceptions and corrective actions. It should not claim that a matching digest proves the photographed construction. Integrity of the file and truth of the depicted condition remain separate propositions.

Worked example 34.34. Hash mismatch during handover

The handover manifest lists 3,412 original photographs. Verification finds five files whose SHA-256 digests do not match the construction repository. The files are quarantined. Comparison shows that an export process rotated and recompressed them while retaining the original names. The original byte-identical files are restored, the derivatives receive new identifiers, and the manifest is regenerated.

501 MB-1025. National Cyber Security Centre, TEMPEST and electromagnetic security public information.

34.35 Handover reconciliation and the evidence dossier

Handover should be a reconciliation process, not a mass upload performed during the final week. The project should compare every requirement, room, boundary segment, hold point, mock-up, penetration, door, material item, nonconformance, test and authority condition with the evidence expected. Missing records should be pursued while personnel and access remain available. UFGS closeout and commissioning practice, RIBA stage guidance and ISO 19650 information-management principles all support planned transition into operation, but the secure-room dossier requires its own security and authority controls.[502][503][504][505]

The dossier should contain both content and navigation. A collection of thousands of well-preserved files is not usable without indexes, registers and relationships. The handover should include a manifest, requirement-to-evidence matrix, room and boundary index, as-built drawings, penetration register, door and seal schedule, material and equipment records, inspection and hold-point releases, photographic index, nonconformance dossier, test reports and raw data, calibration evidence, operating procedures, maintenance requirements, change triggers and authority decisions.

Reconciliation should identify open conditions explicitly. A conditional authority decision, deferred test, temporary repair or missing record should appear in a controlled exceptions register with owner, due date, interim

502 MB-1024. National Cyber Security Centre, Public technical-security policy and guidance resources.
503 MB-1074. National Protective Security Authority, Secure Working Areas, public guidance current at source freeze. Status at the 14 August 2026 source freeze: Current public guidance. Public locator: Use is confined to the source scope. The document d.
504 MB-0445. FCDO Services and UK National Authority for Counter-Eavesdropping, Secure Speech Environments.
505 MB-1303. UK Government, Government Functional Standard GovS 007: Security, public edition current at source freeze. Status at the 14 August 2026 source freeze: Current public standard. Public locator: Use is confined to the source scope. The documen.

control and closure evidence. Labelling the project “substantially complete” does not remove technical uncertainty. The operating organisation must understand what remains provisional.

Table 34-10. Secure construction handover dossier

Dossier component	Principal contents	Primary lifecycle user
Requirement index	Requirement, source, response, evidence and status	Owner and authority
Configuration baseline	As-built drawings, schedules, models and confidence	Facilities and design teams
Construction evidence	Hold points, inspections, photographs and material provenance	Maintenance and forensic review
Registers	Penetrations, doors, seals, equipment, issues and changes	Facilities management
Nonconformance dossier	Causes, dispositions, repairs, verification and retests	Quality and technical authority
Test dossier	Plans, methods, raw data, uncertainty, reports and limitations	Acoustic specialist and authority
Operations package	Procedures, permitted states, maintenance and inspection intervals	Room operator and maintenance staff
Security controls	Information classification, access, retention and destruction	Security management
Exceptions register	Open conditions, interim controls, owners and dates	Project leadership
Integrity package	File manifest, hashes, repository export and validation log	Records custodian

34.35.1 Independent dossier walk-through and operational acceptance

Handover should include an independent walk-through of the dossier by the future custodian, maintenance representative, commissioning provider and an authorised security or facilities representative. The exercise begins with practical questions. Locate every penetration in one selected boundary. Identify the installed seals on one door. Trace a repaired nonconformance from discovery through verification. Find the current HVAC silencer record.

Determine which changes would trigger renewed testing. A dossier that cannot answer these questions without the departing project team has not yet become an operational control instrument.[506]

The walk-through should compare digital records with selected physical assets and should document discrepancies before acceptance; it should also confirm ownership of repositories, backups, encryption keys, access groups, retention schedules and future update duties; training should cover not merely how to open files, but how to preserve configuration status when maintenance or technology changes occur. The final acceptance of the dossier should distinguish completeness, usability, security handling and technical accuracy; a visually polished closeout binder can fail all four. Operational acceptance is achieved when authorised custodians can retrieve, interpret, update and defend the record without relying upon fading recollection or inaccessible contractor systems.

Worked example 34.35. Handover volume without navigation

A contractor delivers 96 GB of photographs, PDFs and spreadsheets; file integrity is sound, but no stable IDs link the records to rooms or requirements. The package fails reconciliation. The contractor builds the missing indexes, maps images to inspection units and registers, and produces a verified manifest; the same bytes become a usable evidence dossier only after their relationships are restored.

34.36 Contractor access, escorts and information handling

Construction access should be planned around the work and the information exposed. Personnel lists, identity verification, badging, escorts,

506 MB-0796. International Electrotechnical Commission, IEC 60268-16:2020.

work areas, tool control, device rules, photography permissions, material deliveries, waste removal and end-of-shift accountability should be defined before mobilisation.[507] The controls must be proportionate. Excessive restriction can force rushed work, inhibit inspection and encourage informal workarounds. Weak control can expose sensitive geometry or permit unrecorded alterations.[508][509]

The access plan should distinguish ordinary construction zones from areas where concealed boundary details, controlled criteria or operational systems are visible; trades should receive the information needed for their task; briefings should explain prohibited actions, required reporting and the reason certain openings or supports cannot be improvised. A culture of unexplained secrecy can cause installers to conceal mistakes rather than ask questions.

Tool and device control should focus on items that can alter, capture or remove information or material; drills, core tools, endoscopes, cameras, storage media and network-capable devices may require special authorisation in some areas; the project should avoid performative inventories that record every hand tool while ignoring cloud-connected cameras or pre-programmed scanning equipment. Return and accountability procedures should be workable at shift change.

Escort logs and access records may support later reconstruction, but they do not prove who performed a specific installation. The inspection and work records should identify responsible crews and observed activities. Security incidents, denied access and escort delays should be recorded because they

507 MB-0384. Cabinet Office, GovS 007, Version 2.0, Government Functional Standard: Security.
508 MB-0383. Cabinet Office, GovS 007, Version 2.0, Government Functional Standard: Security.
509 MB-1066. National Protective Security Authority, ISO 23234:2021.

can explain missed hold points or changed sequences without excusing uncontrolled work.

Worked example 34.36. Access control creates inspection risk

A specialist inspector is granted only a thirty-minute escorted window for eight ceiling-space hold points. The project initially attempts to proceed, then recognises that the window cannot support competent observation. Access is rescheduled in two controlled blocks with a lift and current drawings. The record notes the delay rather than accepting superficial inspection.

34.37 Post-occupancy changes and configuration drift

The secure-room baseline begins to age as soon as the room enters service. Maintenance, furniture installation, technology refresh, cleaning, floor replacement, door adjustment, cable additions and emergency repairs can alter the acoustic boundary. Configuration drift is often produced by reasonable local decisions made without awareness of the original mechanism. A facilities technician may drill a cable hole, replace a seal with available stock, support a display from an isolated wall or leave a ceiling barrier open after service.[510]

The operating organisation should maintain a change-trigger list. Any new penetration, door or hardware change, glazing work, ceiling access, duct modification, control-system addition, structural fixing, finish change at a threshold, water event, firestop disturbance or significant furniture anchorage should receive technical screening before work. The screening decides whether ordinary maintenance records are sufficient, whether

510 MB-1077. National Protective Security Authority, Secure Working Areas, Secure Working Areas.

surveillance and photographic evidence are required, or whether recommissioning and authority review are necessary.

Periodic inspections should concentrate on dynamic and accessible elements, including door seals, thresholds, access panels, visible penetrations, ceiling barriers, equipment mounts and service routes. Records should compare the current condition with the handover baseline. Trend data can reveal accelerating wear or repeated unauthorised changes. The inspection interval should reflect use, consequence and observed stability rather than a universal calendar.

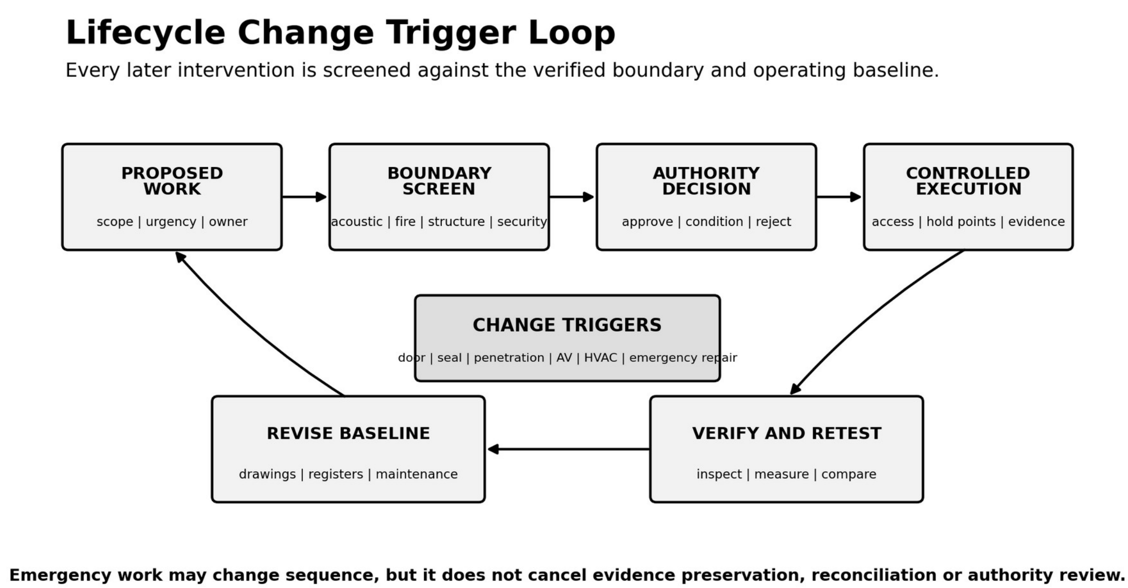

Figure 34-8. Lifecycle change control links proposed work, boundary-impact screening, authorised execution, evidence update, retesting and baseline revision. Author's original diagram.

34.37.1 Incident response and emergency work

Emergency work may require immediate access or opening of the boundary. The procedure should allow life-safety and damage-control action while preserving evidence and triggering restoration. Personnel should record the opening, temporary protection, materials removed, photographs where authorised, responsible persons and time. Once the emergency is controlled, the condition enters the nonconformance and change process.

Water damage deserves particular attention because it can affect board, insulation, seals, doors and electrical systems beyond visible staining. Restoration should identify the wetting extent, drying method, material replacement and effect on tested assemblies. Painting over a dry surface does not prove that concealed absorption or fastening remains suitable.

Worked example 34.37. Technology refresh creates drift

A new conferencing display requires two data cables; the installer proposes drilling through the nearest wall; the change trigger sends the request for review; an existing registered pathway has spare capacity, so no new boundary opening is made. The penetration register, cable schedule and equipment record are updated after installation.

34.38 Case study: a concealed bridge repeated across twelve rooms

A project uses independent double-stud partitions around twelve secure meeting rooms; the design and approved submittals are sound; during rough-in, an electrical subcontractor adds plywood backing for control panels; the backing spans both stud rows because the crew interprets the wall as ordinary construction. The first room receives only a field-wall inspection, and the backing is above the photographed area. No interface-specific hold point exists. The detail is repeated in all twelve rooms and concealed behind two board layers.

Preliminary field testing shows a consistent mid-frequency deficiency; the similarity across rooms suggests a repeated path rather than random seal defects; review of progress photographs reveals the edge of plywood in one image. Selective openings confirm the bridge. The project contains the affected population, removes the backing, installs independently supported panels, repairs the leaves under observation and retests representative rooms; the correction succeeds, but the rework disrupts finishes, systems and programme.

The failure has several causes. The design did not provide a specific equipment-support detail; the surveillance plan classified the wall as repetitive field work rather than an integrated electrical interface. The mock-up omitted control panels. Photographs lacked systematic coverage above the panel zone; the electrical crew was not included in the secure-boundary briefing. Each cause is corrected. The new first-of-type unit includes equipment backing, the hold-point schedule assigns the interface, and the electrical shop drawing receives acoustic review.

The case demonstrates why final testing is necessary but economically late. The test revealed the system-level consequence, yet it could not identify the hidden bridge without forensic investigation. Construction surveillance should not be justified as a substitute for testing. It is the earlier evidence layer that makes conformity more likely and failure diagnosis more efficient.

Worked example 34.38. Rework exposure

Twelve rooms contain 24 affected panel locations; each opening requires protection, demolition, electrical disconnection, backing replacement, board repair, finishing, cleaning and retesting; a five-minute interface inspection during rough-in would have detected the first bridge; the case therefore records not merely the repair cost, but the schedule, operational and evidentiary consequences of a missing hold point.

34.39 Case study: evidence-led first-of-type release

A second project establishes a first-of-type room before releasing twenty repeated rooms. The mock-up includes a door, glazing panel, wall head beneath profiled deck, supply and return silencers, electrical boxes, a sprinkler penetration, data pathways, a raised-floor barrier and an audiovisual display support. Each trade attends the preparatory conference. Inspectors use a shared requirement map but separate their contractual, code, acoustic and security dispositions.

The first installation reveals five correctable problems; a duct transition restricts silencer access; an automatic door bottom contacts an uneven threshold; a cable sleeve exceeds the approved annular range. A display support approaches the isolated leaf. The photographic file names do not preserve room and viewpoint. None of the problems is concealed. The design and sequence are revised, the work is repeated, and the evidence package is tested by an independent reviewer who can reconstruct every critical condition from the register and images.

Production begins only after explicit release. Subsequent rooms use the same work packs, material controls and hold points; sampling is stratified to include doors, columns, services and ordinary wall fields; a lot change in perimeter sealant automatically triggers a renewed initial check; two minor defects and one major penetration departure are detected during production and closed before concealment. Final testing confirms the expected performance range without extensive forensic work.

The project succeeds because surveillance is integrated with procurement, construction and handover; it does not rely on exceptional individual memory; the accepted mock-up, photographs, register schema, nonconformance process and as-built reconciliation create a repeatable system; the programme is not defect-free, but defects are visible, bounded and corrected while evidence remains available.

Worked example 34.39. Avoided defect propagation

The oversized cable sleeve found in the first-of-type room would have appeared in 20 rooms and 60 penetrations. Correction before release prevents repetition. The project records the avoided population as a quality-planning lesson, while recognising that avoided-cost estimates are approximate and should not be presented as measured savings without a defined model.

34.40 Conclusions

Secure construction is an evidentiary engineering process conducted under irreversible sequencing; its central problem is not that walls, doors and services are difficult to see; it is that the most consequential conditions become impossible to see precisely when the project begins to look complete. A reliable programme therefore aligns observation with observability, competence with proposition, evidence with inference and authority with decision.

The surveillance plan should rank risk, identify first-of-type units, place hold points before concealment, control material identity, coordinate acoustic and life-safety details, and create indexed records that another professional can understand without unwritten site knowledge; photographs require location, context, originals, metadata and custody. Registers should operate during construction rather than emerge during closeout; nonconformances require containment, consequence analysis, authorised disposition, corrective verification and retesting where inspection cannot prove the outcome.

The as-built baseline must reconcile what was designed, submitted, installed, tested and authorised; cryptographic hashes can help demonstrate that digital files have not changed, but they cannot transform weak observations into strong evidence; passing field measurements can establish defined performance under defined states, but cannot retrospectively prove every concealed component or waive code and authority duties. Each evidence class remains within its proper scope.

The final discipline is lifecycle continuity. A secure room is not frozen at handover; doors wear, seals age, equipment changes and new services seek the shortest route through existing barriers; the construction dossier therefore becomes an operational instrument; it tells future custodians what exists, why it matters, how it was proved, which conditions were authorised and which changes require renewed surveillance or testing. Chapter 35 takes this verified configuration into laboratory and field measurement, instrumentation, calibration and commissioning.

Chapter 34 Glossary

As-built baseline. Reconciled record of the installed configuration, supported by field evidence and linked registers rather than merely relabelled design drawings.

Chain of custody. Documented history of possession, transfer, access and handling sufficient for the project to reconstruct material events affecting an evidence item.

Concealed-work release. Recorded decision permitting work to proceed beyond a stage at which specified conditions will no longer be directly observable.

Configuration drift. Uncontrolled or insufficiently documented divergence of the operating asset from its approved and verified baseline.

Construction surveillance. Planned observation, measurement and record production used to verify construction-stage conformity and preserve evidence of the installed state.

Context image. Photograph locating an observed condition within a room, boundary or work area.

Corrective action. Action addressing a detected nonconformity and its cause, including verification that the action was effective.

Derivative image. Copy of an original image that has been cropped, annotated, redacted, converted or otherwise changed for interpretation or distribution.

Disposition. Authorised decision defining how a nonconforming condition will be repaired, replaced, redesigned, reworked or accepted with documented justification.

Evidence completeness index. Project screening metric combining weighted completion states of defined evidence classes. It is not proof of conformity or authenticity.

First-of-type mock-up. Representative initial installation used to prove configuration, sequence, workmanship, inspection and evidence before repetitive release.

Hold point. Mandatory stop beyond which work may not proceed until the named release is issued.

Image manifest. Controlled list of image identifiers, file properties, provenance, repository locations and cryptographic digests.

Inspection unit. Defined item, location, interface or work package to which an inspection record and decision apply.

Material provenance. Traceable history connecting an approved product to delivery, identity, storage, incorporation location and final disposition.

Missed hold point. Failure to obtain the required observation or release before the work becomes concealed or otherwise irreversible.

Nonconformance. Failure to fulfil a stated requirement.

Penetration register. Lifecycle record linking each boundary opening to location, service, geometry, approved treatment, inspection, evidence, disposition and later change.

Release authority. Role contractually or institutionally empowered to permit work to proceed at a defined control point.

Risk-ranked surveillance. Allocation of inspection method and intensity according to consequence, defect likelihood, concealment, novelty, repetition and later detectability.

Sample panel. Retained workmanship benchmark showing defined acceptable conditions without purporting to prove whole-assembly performance.

SHA-256 digest. Fixed-length cryptographic value generated from file bytes under the SHA-256 algorithm and used to detect later byte-level change.

Systemic nonconformance. Recurring or process-based departure whose affected population may extend beyond the initially observed locations.

Witness point. Inspection point at which attendance is invited, but work may proceed under specified contractual conditions after proper notice.

PART X. TESTING, FORENSIC DIAGNOSIS, AND LIFECYCLE ASSURANCE

Part X converts the verified construction configuration into reproducible measurement, diagnosis and lifecycle evidence. Chapter 35 defines the laboratory and field methods, instruments, calibration chains, sampling rules, uncertainty models, data controls and commissioning sequence needed to measure what was actually built. Chapter 36 then uses that baseline for forensic failure analysis and remediation.

Chapter 35. Laboratory and Field Measurement, Instrumentation, Calibration, and Commissioning

Measurement begins before a microphone is energised. The project must first identify the proposition to be tested, the physical quantity that represents it, the operating state to be reproduced, the locations that matter, the dynamic range required, and the authority that will interpret the result. A secure-room test is otherwise vulnerable to a polished but irrelevant number; a laboratory rating can be valid for its specimen while saying little about the installed room; a field room-pair result can be valid for its prescribed averages while missing a local listener position. A speech-privacy result can be valid for unaided listening while leaving electronic acquisition outside scope; a competent authority can accept or restrict use, but cannot change the measured physics.

This chapter therefore treats instrumentation as one element of an evidence system; microphones, preamplifiers, analysers, loudspeakers, calibrators, intensity probes, accelerometers, environmental sensors, software and data repositories must be matched to the measurand and state; calibration establishes traceability for defined quantities. Field checks reveal gross drift. Sampling addresses spatial and temporal variation. Background and reverberation corrections preserve the measurement model; uncertainty and decision rules control how results are compared. Commissioning reconciles all of these with the installed configuration and the authorised function.

The governing discipline is separation. Laboratory evidence, installed field performance, occupied speech-security performance and formal authorisation remain distinct. Diagnostic scans, temporary seals and controlled equipment changes can explain a mechanism, but they must be reported as modified-state observations rather than silently substituted for formal acceptance. The final record must enable another competent professional to recover the method, data, processing, limitations and exact room state without relying upon the memory of the original test team.

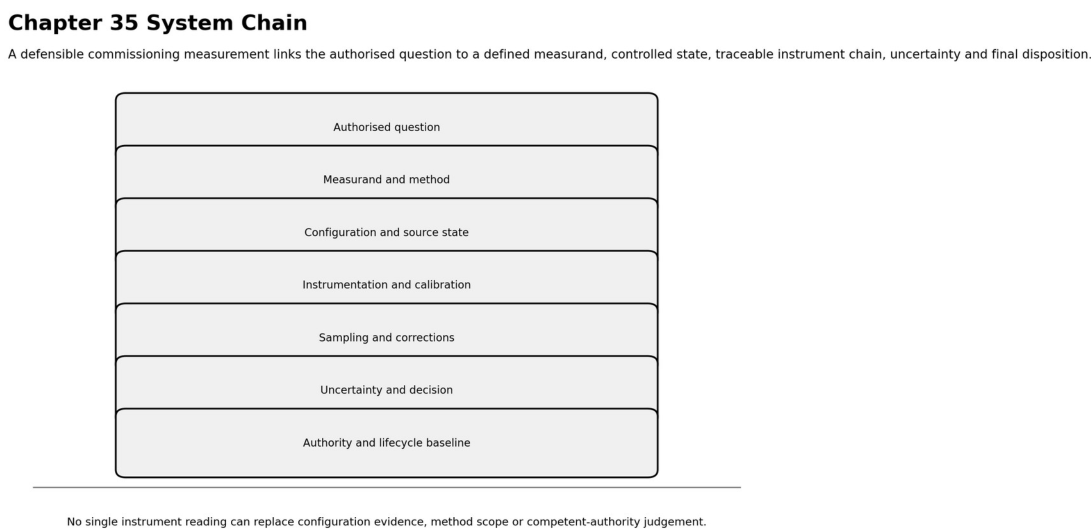

Figure 35-1. A defensible commissioning measurement links the authorised question to a defined measurand, controlled state, traceable instrument chain, uncertainty and final disposition. Author’s original diagram.

35.1 Measurement programme, measurand and four-proposition control

A measurement programme should begin with a written question whose answer can be supported by a defined quantity or observation. Examples include laboratory transmission loss of a specimen, apparent field sound insulation between rooms, normalised door insertion loss, room-to-room plenum attenuation, reverberation time, local surface intensity, vibration mobility, masking level, or objective closed-room speech privacy. These quantities are related, but they do not answer the same question. [511][512][513][514][515]

Category error arises when a project uses the instrument display rather than the authorised decision to choose the measurand. A class 1 analyser can calculate many quantities, yet the calculation remains meaningless if the source state, room geometry, correction model or listener access does not correspond to the requirement. The four-proposition model prevents this error by keeping laboratory specimen performance, installed field performance, occupied speech-security performance and competent-authority acceptance separate. Within measurement programme, measurand and four-proposition control, the decisive analysis follows the complete source-path-receiver chain and records each interface capable of carrying pressure, force, information or measurement bias.

The test basis should identify requirement identifier, proposition, measurand, method and edition, source and receiver states, room configuration, frequency range, positions, environmental conditions, corrections, uncertainty, decision rule, witnesses, data controls and authority. Every supplemental diagnostic observation should be labelled by purpose and should identify any temporary modification. The design record for measurement programme, measurand and four-proposition control should translate those mechanisms into dimensions, products, tolerances, support conditions, inspection stages and named ownership.

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511 MB-0379. Cabinet Office, Government Security Classifications Policy, Government Security Classifications Policy.
512 MB-1076. National Protective Security Authority, Secure Working Areas, Secure Working Areas.
513 MB-1067. National Protective Security Authority, Build it Secure, Security risk management, Operational Requirement and project-lifecycle guidance.
514 MB-0868. International Organization for Standardization, ISO 16283-1:2014, ISO 12999-1:2020.
515 MB-1073. National Protective Security Authority, Secure Rooms, Secure Rooms.

The report should state the quantity obtained and the inference permitted; it should also state what the quantity does not prove; a field result under one HVAC and masking state cannot establish performance under every credible state, while a passing acoustic result cannot certify electronic, cyber, EMSEC or TSCM conditions. Measurement precision does not cure an incorrectly defined question; evidence concerning measurement programme, measurand and four-proposition control should identify the exact observed unit, method, instrument chain, state, limitations and inference supported.

Worked example 35.1. Metric selection for one room pair

A project has a contractual requirement for installed apparent sound insulation, an operational concern about speech audibility in a service cupboard, and an authority decision about protected use. Identify the evidence sequence rather than subtracting unlike headline ratings.

$$E=\{R_{lab},D_{field}(f),P_{speech},A_{authority}\}$$

R_lab denotes specimen evidence, D_field(f) denotes frequency-resolved installed field evidence, P_speech denotes occupied speech evidence under a defined listener model, and A_authority denotes the institutional decision.

The four evidence objects are reported separately and then reconciled. No arithmetic conversion makes one object equivalent to another.

The notation is an evidence set, not a physical equation or universal acceptance model.

35.2 Test plan, source-state matrix and readiness review

A test plan is a controlled engineering document, not a diary entry written after arrival. It should identify the room pair, boundary, source states, adjoining access, instruments, calibration, measurement grid, environmental state, required services, quiet and failure modes, safety controls, information handling, acceptance rule and contingency process. Readiness review confirms that the room is complete enough to measure and stable enough to interpret. [516][517][518][519][520]

Source-state variation can dominate the result. Human speech changes with vocal effort, orientation, distance and Lombard response; conference systems change gain, bandwidth, directivity and software state; HVAC, masking, doors and pressure alter both transmitted level and receiving background; a single convenient loudspeaker condition cannot represent every authorised use unless the basis explicitly makes that assumption. For test plan, source-state matrix and readiness review, the mechanism must be traced from excitation through materials, supports, openings, controls and adjoining spaces rather than inferred from the trade name of one component.

The source-state matrix should include seated conversation, raised speech near vulnerable boundaries, installed conferencing, presentation audio, emergency systems, maintenance modes and any prohibited state that must be verified as unavailable. Each state needs an owner, level and spectrum, position, duration, software configuration, door and service condition, evidence method and disposition. Accordingly, test plan, source-state matrix and readiness review requires a controlled configuration with

516 MB-0453. FCDO Services, ISO 16283-1:2014.
517 MB-1068. National Protective Security Authority, ISO 16283-1:2014, ISO 3382-2:2008.
518 MB-1069. National Protective Security Authority, Building Services and Internal Spaces, Building Services and Internal Spaces.
519 MB-0867. International Organization for Standardization, ISO 16283-1:2014, ISO 12999-1:2020.
520 MB-0447. FCDO Services, ISO 3382-2:2008, IEC 60268-16:2020.

stable identifiers, coordinated details, access provisions and change triggers that remain usable after handover.

Pretest inspection should reconcile the matrix with the current asset inventory, drawings, penetration and doorset registers, masking settings, HVAC controls and room contents. Open nonconformances and temporary works should be dispositioned before formal acceptance testing begins. A test conducted before final balancing, door adjustment or software commissioning measures an interim state even when the data are technically excellent. Verification of test plan, source-state matrix and readiness review should combine documentary reconciliation, direct observation and measurement without allowing one evidence class to substitute silently for another.

Worked example 35.2. Source drift during a measurement series

A reference microphone records 93.0 dB at the beginning, 92.4 dB halfway through and 91.8 dB at the end of a test. Estimate the maximum drift from the initial state.

$$\Delta L_{max} = 91.8 - 93.0 = -1.2\, dB$$

Delta L_max is the maximum observed source-level change relative to the initial reference.

The source fell by 1.2 dB. Depending on the method, uncertainty and sequence, the team may correct valid data, repeat affected bands or reject the series.

A single reference point does not prove that source directivity or room distribution remained unchanged.

35.3 Laboratory facilities, specimen identity and transmission loss

Laboratory sound-insulation measurement characterises a defined specimen installed in a specialised facility. ASTM E90 and the ISO 10140 series require controlled source and receiving rooms, specimen mounting, frequency-resolved measurement, receiving-room absorption or decay information and suppression or accounting of unwanted paths. The result belongs to the complete tested configuration, not to a generic material name. [521][522][523][524][525][526]

Specimen identity includes dimensions, surface mass, framing, cavities, absorbers, fasteners, joints, seals, perimeter, openings, hardware, orientation, environmental conditioning and mounting. Doors, glazing, transit seals, transfer-air elements and composite systems are especially sensitive to apparently minor differences. Laboratory flanking suppression is intentional and differs from the whole-building network found in the field. The engineering model for laboratory facilities, specimen identity and transmission loss should identify which physical variables change with frequency, operating state, loading, access, maintenance and environmental condition.

A submittal should provide the complete test report, facility and laboratory identity, method edition, specimen drawings, photographs, installation

521 MB-0460. FCDO Services, UK NACE, Technical Surveillance Countermeasures, Technical Surveillance Countermeasures.
522 MB-0465. FCDO Services, UK National Authority for Counter-Eavesdropping, UK NACE, The UK National Authority for Counter-Eavesdropping.
523 MB-0459. FCDO Services, UK NACE, Technical Surveillance Countermeasures, Technical Surveillance Countermeasures.
524 MB-0451. FCDO Services, UK NACE, Construction Security, Construction Security.
525 MB-0450. FCDO Services, UK NACE, Construction Security, Construction Security.
526 MB-1080. National Protective Security Authority, Security-Minded Approach to Information Management, Security-Minded Approach to Information Management.

details, frequency data, background and dynamic-range statements, deviations, uncertainty or precision information, and the single-number classification derived under the applicable rating standard. Summary certificates and marketing tables are supplementary only. Design development should assign every consequential interface in laboratory facilities, specimen identity and transmission loss to a responsible discipline and should resolve acoustic, structural, fire, accessibility and service obligations together.

Design comparison should use frequency bands and specimen similarity before relying upon STC, R_w or another single number. Where the proposed assembly differs, the reviewer should identify whether the difference affects mass, stiffness, damping, leakage, resonance, coincidence, frame behaviour or flanking interfaces. A laboratory report cannot establish field workmanship, building flanking, room background, listener access or governmental authorisation. The acceptance record for laboratory facilities, specimen identity and transmission loss should preserve raw data, calibration, photographs, dimensions, processing and the decision rule needed for later reproduction.

Worked example 35.3. Composite laboratory boundary dominated by a door

A 30 m2 wall has transmission loss 60 dB in one band. A 2.2 m2 doorset in the wall has transmission loss 38 dB. Calculate the ideal area-weighted composite transmission loss.

$$\tau_c = \frac{30\left(10^{-6}\right) + 2.2\left(10^{-3.8}\right)}{32.2}, R_c = -10\log_{10}\left(\tau_c\right)$$

tau_c is the composite power transmission coefficient. R_c is the idealised composite transmission loss in decibels.

The composite coefficient is about 1.176 x 10^-5 and R_c is about 49.3 dB. The small doorset controls the idealised boundary.

The calculation omits frame leakage, flanking, room effects and field installation.

35.4 Field room-pair sound insulation under ASTM and ISO methods

Field methods measure the installed relation between spaces or the apparent behaviour of a separating element under prescribed conditions. ASTM E336-25a distinguishes metrics including NR, NIC, NNR, NNIC, ATL and ASTC and states that they are not interchangeable. ISO 16283-1:2014 provides procedures for airborne sound insulation between rooms across a stated volume and frequency range. Both methods require controlled source and receiving sampling, background treatment and receiving-room information. [527][528][529][530][531]

The installed result includes direct transmission and relevant flanking paths; room volume, absorption, modal behaviour, furnishings, source directivity, doors, services and geometry influence the measurements; the field quantity can therefore differ materially from the laboratory rating without any single component being defective. Conversely, a room-average quantity can conceal a local hot spot important to the threat model; a credible treatment of field room-pair sound insulation under astm and iso methods

527 MB-0452. FCDO Services, ISO 23234:2021.
528 MB-0866. International Organization for Standardization, ISO 16283-1:2014, ISO 12999-1:2020.
529 MB-0865. International Organization for Standardization, ISO 16283-1:2014, IEC 60268-16:2020.
530 MB-0854. International Organization for Standardization, ISO 12999-1:2020, JCGM 100:2008.
531 MB-0446. FCDO Services, ISO 12999-1:2020.

distinguishes direct transmission, structural coupling, connected air paths, regenerated sound and observational uncertainty before selecting a remedy.

The test plan should select the method and quantity because they match the requirement. Source and microphone positions should satisfy the method while also documenting practical constraints. Supplemental listener-access positions, local scans and operating-state contrasts should be recorded separately and should not replace mandatory averages. The project documents should make field room-pair sound insulation under astm and iso methods buildable and inspectable by defining geometry, sequence, acceptable variation, substitute evidence and the point at which concealment is prohibited.

Reports should retain band data, room dimensions and volumes, source and receiver positions, absorption or decay data, background corrections, instrumentation, calibration, operating state, deviations, uncertainty and the classification process. Temporary sealing or muting used for diagnosis must be conspicuous. Subtracting NIC from ASTC, or an ISO DnT,w value from an ASTM STC, is not a valid deterioration calculation. A favourable observation of field room-pair sound insulation under astm and iso methods remains bounded to the inspected population and measured state, while unseen conditions and untested modes associated with field room-pair sound insulation under astm and iso methods remain explicit limitations.

Worked example 35.4. Standardised level difference

A measured level difference is D = 47.0 dB. Receiving-room reverberation time is T = 0.80 s and the selected reference is T0 = 0.50 s. Calculate the standardised level difference under the stated convention.

$$D_{nT} = D + 10\log_{10}\left(\frac{T}{T_0}\right)$$

D_nT is standardised level difference, D is measured level difference, T is receiving-room reverberation time and T0 is the reference time.

The correction is about 2.04 dB, so D_nT is about 49.0 dB.

The result applies only to the method and sign convention used. It does not remove flanking, spatial variation or configuration uncertainty.

35.5 Doorset field measurement and operable-state control

An installed door is an operable subsystem whose performance depends on leaf, frame, anchors, seals, threshold, hardware, latch, closer, automatic bottom, vision panel, wall interface, pressure and floor finish. ASTM E2964-26 provides a field method using normalised insertion loss and a door transmission class for suitable doors. Whole-room methods continue to measure the composite room relation. [532][533][534][535]

Door performance changes during closing, latching, access-controlled release, power loss, fire alarm, automatic operation and pressure reversal. A static photograph cannot establish compression or contact. A laboratory door STC may exceed the field DTC because of installation and residual flanking, while a whole-room result can be dominated by another path. Analysis of doorset field measurement and operable-state control begins by mapping the actual configuration, because small differences in geometry, restraint, continuity or software state can reverse the dominant path.

532 MB-0454. FCDO Services, UK NACE, Monitoring, Technical Monitoring for Secure Environments.
533 MB-0389. Cabinet Office, Security Policy Framework, Protecting Government Assets.
534 MB-0458. FCDO Services, UK NACE, Technical Surveillance Countermeasures, Technical Surveillance Countermeasures.
535 MB-0385. Cabinet Office, GovS 007, Version 2.0, Government Functional Standard: Security.

The commissioning sequence should include geometry and gap mapping, hinge and frame condition, latch engagement, seal contact, automatic-bottom timing, threshold support, operating force, pressure states, access controls and emergency modes. The exact tested state and hardware revisions should be preserved. A robust specification for doorset field measurement and operable-state control combines performance language with prescriptive detail wherever the mechanism cannot be verified from a final single-number test.

Field door data should be accompanied by photographs, dimensions, source and microphone geometry, background, scanning or fixed-microphone method, normalisation, corrections and uncertainty. Local high-frequency scans may guide adjustment but should remain diagnostic. A door adjusted temporarily beyond accessible operating force does not represent an acceptable final configuration. Testing of doorset field measurement and operable-state control should report band data and operating conditions before any summary rating, so that background, flanking, drift and method scope can be examined.

Worked example 35.5. Energetic effect of one perimeter segment

Three equal-length door-perimeter segments provide local level differences of 48, 49 and 37 dB under the same diagnostic source. Calculate the energetic mean rather than the arithmetic mean.

$$\overline{D}_E = -10\log_{10}\left(\frac{10^{-4.8}+10^{-4.9}+10^{-3.7}}{3}\right)$$

D-bar_E is the energetic mean of equal-area transmission contributions.

The energetic mean is about 41.6 dB. The weak segment dominates, whereas the arithmetic mean would misleadingly give 44.7 dB.

Local diagnostic segments do not by themselves produce the formal DTC or whole-room rating.

35.6 Ceiling plenums, raised floors, ducts and silencers

Common plenums, access floors, transfer openings and duct networks can bypass otherwise strong room boundaries. ASTM E1414/E1414M-21a addresses room-to-room attenuation through a common ceiling plenum under its prescribed arrangement. ASTM E477 and ISO silencer methods characterise defined acoustical and airflow performance. Field duct and plenum behaviour remains dependent on branches, terminals, casing breakout, regenerated noise, supports, pressure and flow state. [536][537][538][539][540]

A silencer insertion-loss curve does not equal room-to-room isolation. Speech can bypass the silencer through relief branches, casing radiation, shared return paths, access panels or structural supports. A suspended ceiling can contribute attenuation only within the tested or justified system, while a deck-to-deck barrier changes the controlling path family. Raised floors create similar underfloor networks. The controlling behaviour of ceiling plenums, raised floors, ducts and silencers is system dependent and cannot be reduced to one catalogue value when adjacent construction and services participate in the measured response.

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536 MB-0457. FCDO Services, UK NACE, Technical Surveillance Countermeasures, Technical Surveillance Countermeasures.
537 MB-1020. Ministry of Housing, Communities and Local Government, Approved Document B, Volume 2, Fire Safety in Buildings Other Than Dwellings.
538 MB-1075. National Protective Security Authority, Secure Working Areas, Secure Working Areas.
539 MB-1019. Ministry of Defence, Industry Security Assurance Centre, Security Aspects Letter guidance, Security Aspects Letters and contractual security obligations.
540 MB-0768. Government Security Group, Government Security Standards portal, Standards across government security disciplines.

The test plan should map every branch and state, identify source and receiver terminals, fan speed, damper position, filter state, airflow, pressure, ceiling configuration and access panels. Diagnostic contrasts can include branch muting, terminal closure, plenum barrier intervention and flow-state change, provided collateral effects are recorded. Procurement and submittal review should preserve the tested or approved identity of ceiling plenums, raised floors, ducts and silencers, including the features whose alteration would invalidate comparison with the supporting evidence.

Commissioning should combine formal room-pair evidence with system-specific observations and airflow data. Reports should separate attenuation, insertion loss, regenerated noise, background and casing or structural transmission. A fan-off result may improve source isolation while simultaneously removing beneficial background and changing damper position. Where ceiling plenums, raised floors, ducts and silencers is evaluated by intervention, the record should describe collateral changes and restoration duties before attributing the observed difference to one mechanism.

Worked example 35.6. Parallel plenum and wall paths

An idealised wall path contributes transmission coefficient 2.0 x 10^-6 and a plenum path contributes 1.0 x 10^-5 to the same receiving state. Calculate the combined equivalent loss.

$$\tau_{tot} = 2.0 \times 10^{-6} + 1.0 \times 10^{-5}, R_{eq} = -10 \log_{10}(\tau_{tot})$$

tau_tot is the sum of independent energetic path coefficients and R_eq is the equivalent loss.

The total coefficient is 1.2 x 10^-5 and the equivalent loss is about 49.2 dB. The plenum controls most transmitted energy.

Real paths may be correlated, spatially distributed and state dependent. The screen does not predict a standard field metric.

35.7 Microphones, preamplifiers, analysers and channel architecture

The measurement chain must suit the expected level, frequency range, field condition and uncertainty. Measurement microphones differ in diameter, sensitivity, self-noise, maximum level, polarisation, environmental response and free-field, pressure-field or random-incidence correction. Preamplifiers, cables, input stages, filters, analogue-to-digital converters and software complete the channel. [541][542][543][544]

High-isolation measurements can require high source levels and very low receiving levels in the same band; one channel may approach overload while another approaches the noise floor; multi-channel systems add phase, clock and gain-matching requirements; automatic ranging, weighting, detector selection and firmware can alter data if not fixed and recorded. For the question addressed in section 35.7, microphones, preamplifiers, analysers and channel architecture is examined as a time-varying network whose inputs, boundaries and receiver conditions must all remain explicit.

The equipment schedule should identify manufacturer, model, serial number, microphone type, preamplifier, analyser, firmware, calibration

541 MB-0387. Cabinet Office, GovS 007, Version 2.0, Government Functional Standard: Security.
542 MB-0386. Cabinet Office, GovS 007, Version 2.0, Government Functional Standard: Security.
543 MB-1208. Treasury Board of Canada Secretariat, Policy on Government Security. Identifier: Policy instrument 16578. Status at the 16 August 2026 source freeze: Current.
544 MB-1201. Treasury Board of Canada Secretariat, Policy on Government Security. Identifier: Policy instrument 16578. Status at the 16 August 2026 source freeze: Current.

date, field correction, channel mapping, gain, filters, sampling rate, anti-aliasing, time weighting, averaging and environmental limits. Class 1 performance under IEC 61672-1 should be specified where required by the method. For microphones, preamplifiers, analysers and channel architecture, the room data sheet and requirement matrix should state source states, adjoining access, operating modes, lifecycle duties and the accepting authority.

Pretest checks should include noise-floor screening, overload margin, channel substitution, cable integrity, battery or power state and time synchronisation. The recorded instrument class does not prove that a specific microphone orientation or correction was appropriate. A display with extra decimal places does not create lower uncertainty. The dossier for microphones, preamplifiers, analysers and channel architecture should distinguish as-designed, as-submitted, as-installed, as-tested, as-authorised and as-operated states.

Worked example 35.7. Microphone voltage from acoustic sensitivity

A microphone sensitivity is 50 mV/Pa. The incident RMS pressure is 0.20 Pa. Estimate the microphone RMS output before preamplifier gain.

$$V_{rms} = M\,p = \left(50 \times 10^{-3}\right)\left(0.20\right) = 0.010\,V$$

M is microphone sensitivity in volts per pascal and p is RMS acoustic pressure in pascals.

The microphone output is 10 mV RMS. Gain and input range should preserve overload margin for higher peaks.

Sensitivity varies with frequency, environment and calibration. The example ignores phase and loading.

35.8 Calibration traceability, field checks and drift control

Calibration is a documented relation between instrument indication and reference quantity with stated uncertainty and traceability. ISO/IEC 17025 addresses laboratory competence, impartiality and consistent operation. IEC 60942 specifies sound-calibrator performance classes. Periodic laboratory calibration and field checks serve different purposes and should not be conflated. [545][546][547][548][549]

A field calibrator check before and after measurement can reveal gross sensitivity change, poor coupling, damaged microphones or channel errors. It does not validate the calibrator beyond its own status, the analyser filters, source geometry, microphone position, background correction or the complete method. Environmental pressure, temperature and humidity can affect calibrator and microphone behaviour. The physical inquiry into calibration traceability, field checks and drift control separates what carries energy from what merely appears defective, thereby preserving alternative hypotheses until discriminating evidence is obtained.

The calibration plan should list required laboratory intervals, field-check levels and frequencies, permitted drift, environmental corrections, reference equipment, certificates, serials, uncertainty, out-of-tolerance response and

545 MB-1207. Treasury Board of Canada Secretariat, Policy on Government Security. Identifier: Policy instrument 16578. Status at the 16 August 2026 source freeze: Current.
546 MB-1200. Treasury Board of Canada Secretariat, Policy on Government Security. Identifier: Policy instrument 16578. Status at the 16 August 2026 source freeze: Current.
547 MB-1203. Treasury Board of Canada Secretariat, ISO/IEC 17025:2017.
548 MB-1206. Treasury Board of Canada Secretariat, Policy on Government Security. Identifier: Policy instrument 16578. Status at the 16 August 2026 source freeze: Current.
549 MB-1200. Treasury Board of Canada Secretariat, Policy on Government Security. Identifier: Policy instrument 16578. Status at the 16 August 2026 source freeze: Current.

data quarantine. Multi-channel phase-sensitive work may require amplitude and phase verification beyond a single acoustic level check. The design team should provide maintainable routes, inspection access and authorised replacement criteria so that later work on calibration traceability, field checks and drift control does not silently alter the boundary.

The test record should preserve pre and post values for every channel, calibrator serial and status, adapter, environmental state and any correction. If drift exceeds the pre-authorised limit, the team should determine which data are affected rather than applying an undocumented blanket adjustment. A current certificate does not prove correct use on site. Inspection and measurement of calibration traceability, field checks and drift control should be scheduled while the controlling condition is still observable, with missed hold points treated as missing evidence rather than acceptance.

Worked example 35.8. Field calibration drift

A channel reads 93.94 dB before testing and 93.62 dB afterwards when exposed to the same nominal calibrator output. Calculate the change.

$$\Delta L_{cal} = 93.62 - 93.94 = -0.32\,dB$$

Delta L_cal is the post-minus-pre field-check change.

The channel changed by -0.32 dB. The project compares this with its pre-authorised drift limit and uncertainty budget.

The difference can include coupling repeatability and environmental effects, not merely microphone sensitivity drift.

35.9 Acoustic source systems, spectral stability and spatial excitation

A source system for sound-insulation measurement should produce adequate level and spectral coverage without overload, excessive distortion or unstable directivity. Loudspeaker, amplifier, signal generator, equalisation, position, orientation, distance from boundaries and source-room response all affect the field. Rotating or multiple source positions may be required to sample different modal and directional conditions. [550][551][552][553][554]

Broadband noise, swept sine, maximum-length sequence, impulse response and programme signals have different uses. A source that is strong in mid bands may be inadequate at low frequency, while aggressive equalisation can exhaust amplifier or loudspeaker headroom. Audible rattles or nonlinear limiters can contaminate the test and excite paths not represented by ordinary speech. Evaluation of acoustic source systems, spectral stability and spatial excitation requires a scale-appropriate model, from local joint or support behaviour through room-level and whole-building consequences.

The source specification should define signal, bandwidth, crest factor, stability, reference monitoring, amplifier and loudspeaker limits, positions, orientations, equalisation, warm-up, distortion screening and operating duration. Installed audiovisual sources should be tested separately as operational source states rather than substituted automatically for standard

550 MB-1205. Treasury Board of Canada Secretariat, Policy on Government Security. Identifier: Policy instrument 16578. Status at the 16 August 2026 source freeze: Current.
551 MB-1199. Treasury Board of Canada Secretariat, Directive on Security Screening. Identifier: Policy instrument 32805. Status at the 16 August 2026 source freeze: Current.
552 MB-1198. Treasury Board of Canada Secretariat, Directive on Security Screening. Identifier: Policy instrument 32805. Status at the 16 August 2026 source freeze: Current.
553 MB-1151. Royal Canadian Mounted Police, Guide to the Application of Physical Security Zones. Identifier: GCPSG-015.
554 MB-1149. Royal Canadian Mounted Police, ASTM E336-25a, ASTM E2638-24.

sources. Details governing acoustic source systems, spectral stability and spatial excitation should be coordinated in three dimensions, with movement, supports, penetrations, terminations and control states shown rather than left to site improvisation.

Reference-channel data should be retained through the series; where source positions are averaged, the method and energetic calculation should be explicit; changes in directivity or room distribution should not be hidden by one overall level check; a stable electrical input does not prove a stable acoustic field. Reports on acoustic source systems, spectral stability and spatial excitation should separate observation, calculation, interpretation, residual alternatives and competent-authority disposition.

Worked example 35.9. Energetic average of source-room levels

Three valid source positions produce band levels 94.0, 91.0 and 93.0 dB at the required source-room sampling set. Calculate the energetic average.

$$L_E = 10\log_{10}\left(\frac{10^{9.4}+10^{9.1}+10^{9.3}}{3}\right)$$

L_E is the energetic average sound-pressure level in decibels.

The energetic average is about 92.9 dB.

The average does not demonstrate diffuse-field conditions or uniform spatial excitation.

35.10 Spatial sampling, temporal averaging and statistical dependence

Rooms contain standing waves, boundary interference, directional fields and local leakage regions. Sampling must therefore represent the quantity defined by the method rather than merely accumulate many points. Closely spaced positions can be strongly correlated, while a sparse grid can miss a controlling local path. Temporal averaging must also reflect source stability and intermittent system states. [555][556][557][558][559]

Standard room averages and threat-informed listener positions answer different questions; a formal grid may estimate a room quantity; a latch-jamb point, service cupboard or ceiling void may represent a practical access condition; the latter should supplement the former and remain labelled. Moving-microphone scans introduce path, speed and dwell assumptions that differ from fixed positions. The mechanism associated with spatial sampling, temporal averaging and statistical dependence should be stated in measurable terms, including the quantities, directions, frequency bands and operational states that could control the result.

The sampling plan should define strata by room, surface, height, access, path family and operating state. It should specify position tolerances, boundary clearance, randomisation or sequence, dwell time, repeat observations and treatment of invalid points. Clustered defects and correlated fields should prevent naive independence assumptions. The selected treatment of spatial sampling, temporal averaging and statistical

555 MB-1148. Royal Canadian Mounted Police, Guide to the Application of Physical Security Zones. Identifier: GCPSG-015.
556 MB-1193. Treasury Board of Canada Secretariat, ISO 19650-5:2020.
557 MB-1195. Treasury Board of Canada Secretariat, Directive on Security Management. Identifier: Policy instrument 32611. Status at the 16 August 2026 source freeze: Current public directive and mandatory procedures. Public locator: Technical role: Depa.
558 MB-1189. Treasury Board of Canada Secretariat, Directive on Security Management. Identifier: Policy instrument 32611. Status at the 16 August 2026 source freeze: Current public directive and mandatory procedures. Public locator: Technical role: Depa.
559 MB-1143. Public Services and Procurement Canada, Contract Security Program, Work site security requirements. Status at the 16 August 2026 source freeze: Current public guidance at source freeze. Public locator: Technical role: Document safeguarding.

dependence should remain effective under credible extremes, not merely under the convenient condition used for an early demonstration.

Reports should preserve coordinates, orientation, height, sequence and actual dwell; statistical summaries should state whether they describe arithmetic, energetic, spatial, temporal or population averages; outliers should be investigated rather than automatically discarded; more points do not compensate for sampling the wrong domain. A result for spatial sampling, temporal averaging and statistical dependence cannot be extended automatically to another room, product, geometry, season or software state without an explicit equivalence analysis.

Worked example 35.10. Effective sample size under correlation

A scan records n = 20 positions with an approximate common pairwise correlation rho = 0.30. Use a simple equicorrelation screen for effective independent sample size.

$$n_{eff} = \frac{n}{1 + (n - 1)\rho} = \frac{20}{1 + 19(0.30)}$$

n_eff is the screening effective sample size, n is the number of observations and rho is assumed common correlation.

The screen gives n_eff about 3.0. Twenty closely related points may contain information comparable to only a few independent positions.

Real spatial covariance is not equicorrelated. The formula is a warning against false precision, not a substitute for a spatial model.

Table 35-1. System, principal mechanism and required evidence

System or subject	Principal mechanism	Required evidence
Measurement programme, measurand and four-proposition control	Category error arises when a project uses the instrument display rather than the authorised decision to choose the measurand	The report should state the quantity obtained and the inference permitted
Test plan, source-state matrix and readiness review	Source-state variation can dominate the result	Pretest inspection should reconcile the matrix with the current asset inventory, drawings, penetration and doorset registers, masking settings, HVAC controls and room contents
Laboratory facilities, specimen identity and transmission loss	Specimen identity includes dimensions, surface mass, framing, cavities, absorbers, fasteners, joints, seals, perimeter, openings, hardware, orientation, environmental conditioning and mounting	Design comparison should use frequency bands and specimen similarity before relying upon STC, R_w or another single number
Field room-pair sound insulation under ASTM and ISO methods	The installed result includes direct transmission and relevant flanking paths	Reports should retain band data, room dimensions and volumes, source and receiver positions, absorption or decay data, background corrections, instrumentation, calibration, operating state, deviations, uncertainty and the classification process
Doorset field measurement and operable-state control	Door performance changes during closing, latching, access-controlled release, power loss, fire alarm, automatic operation and pressure reversal	Field door data should be accompanied by photographs, dimensions, source and microphone geometry, background, scanning or fixed-microphone method, normalisation, corrections and uncertainty
Ceiling plenums, raised floors, ducts and silencers	A silencer insertion-loss curve does not equal room-to-room isolation	Commissioning should combine formal room-pair evidence with system-specific observations and airflow data
Microphones, preamplifiers, analysers and channel architecture	High-isolation measurements can require high source levels and very low receiving levels in the same band	Pretest checks should include noise-floor screening, overload margin, channel substitution, cable integrity, battery or power state and time synchronisation

System or subject	Principal mechanism	Required evidence
Calibration traceability, field checks and drift control	A field calibrator check before and after measurement can reveal gross sensitivity change, poor coupling, damaged microphones or channel errors	The test record should preserve pre and post values for every channel, calibrator serial and status, adapter, environmental state and any correction
Acoustic source systems, spectral stability and spatial excitation	Broadband noise, swept sine, maximum-length sequence, impulse response and programme signals have different uses	Reference-channel data should be retained through the series
Spatial sampling, temporal averaging and statistical dependence	Standard room averages and threat-informed listener positions answer different questions	Reports should preserve coordinates, orientation, height, sequence and actual dwell
Background-noise correction and dynamic-range limitation	Background changes with HVAC, masking, traffic, weather, equipment, occupancy and time	The correction equation, measured difference and accepted limit should be recorded
Reverberation decay, absorption area and room correction	A single reverberation number can hide non-exponential decay, modal behaviour, multiple slopes and changing background	Band decay curves and fit diagnostics should be retained
Vibration measurement, phase, coherence and structural paths	Sensor mass, mounting stiffness, orientation, cable restraint, magnetic bases, adhesive layers and local curvature affect the result	Reports should preserve complex spectra where phase matters, not merely magnitude screenshots
Sound intensity, surface scanning and local radiation	Reactive near fields, insufficient pressure-residual-intensity capability, probe spacing, phase mismatch, airflow, background, scanning speed and surface definition can distort results	Reports should preserve signed band data, surface area, coordinates, quality indicators, calibration, phase verification and excluded regions
Façade, exterior and weather-dependent measurement	A façade can transmit through glass, frames, spandrels, vents, drainage cavities, mullions, roof interfaces and structural anchors	Reports should distinguish façade element evidence, whole-room interior response and operational speech consequences
Masking, objective speech privacy and intelligibility metrics	Masking raises receiving background but does not repair the boundary	The report should state listener assumptions, background state, source effort, language or signal, duration, positions and authority criteria
Measurement uncertainty, covariance and model adequacy	Uncertainty contributors can include calibration, repeatability, position, source stability, background, reverberation, room volume, area, environmental state, filter response, data processing and classification	Sensitivity analysis should show which inputs control the result and which additional evidence would matter

System or subject	Principal mechanism	Required evidence
Decision rules, guard bands and acceptance risk	Producer and consumer risks are not necessarily symmetrical	Reports should show the estimate, uncertainty, guarded quantity, limit and disposition as separate fields
Raw data, metadata, processing and digital integrity	Processing choices such as window, overlap, averaging, filter implementation, weighting, decay fit, excluded samples, background correction and classification can materially change results	SHA-256 digests can make byte-level alteration detectable when manifests are preserved
Commissioning sequence, integrated systems and final authority record	Integrated systems can invalidate an otherwise valid room test	The final dossier should reconcile as-designed, as-submitted, as-installed, as-tested, as-authorised and as-operated states

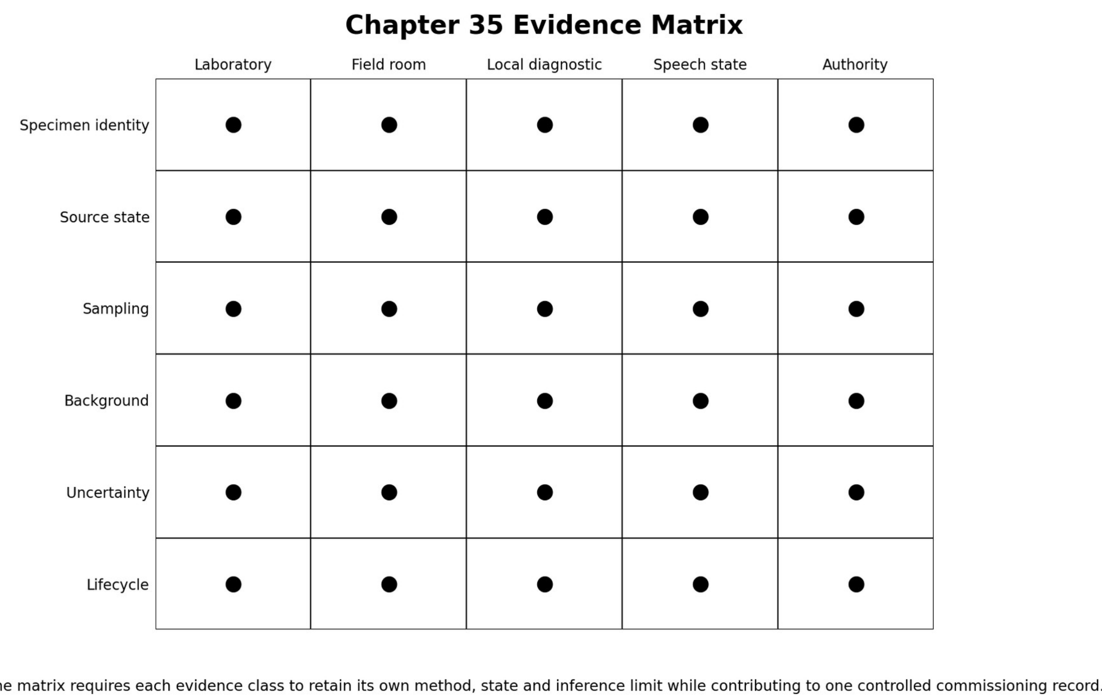

Figure 35-2. The matrix requires each evidence class to retain its own method, state and inference limit while contributing to one controlled commissioning record. Author's original diagram.

35.11 Background-noise correction and dynamic-range limitation

Receiving levels near background are censored by the measurement environment. The observed level is the energetic sum of transmitted test signal and background. Correction becomes increasingly sensitive as the difference narrows, and below a method-defined separation the result may be limited rather than corrected confidently. Quiet rooms, high-isolation boundaries and low-frequency bands are especially demanding. [560][561][562][563][564]

Background changes with HVAC, masking, traffic, weather, equipment, occupancy and time. Turning systems off can reduce background but can also change pressure, dampers, duct paths and room state. Increasing the source can improve dynamic range but may cause nonlinear source behaviour, rattles, saturation or an unrepresentative excitation state. In background-noise correction and dynamic-range limitation, interfaces ordinarily deserve more scrutiny than uniform fields because movement, access, fasteners, penetrations and later work concentrate uncertainty there.

The plan should establish target margin, maximum safe source level, quiet periods, equipment shutdown rules, state logging and band-specific response to inadequate dynamic range. Source and background should be measured in comparable configurations. Limiting bands should remain visible in the report and rating process. Where background-noise correction and dynamic-range limitation depends upon workmanship or configuration,

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560 MB-1136. Public Services and Procurement Canada, Contract Security Program, Contract Security Manual. Identifier: Effective 13 August 2020. Status at the 16 August 2026 source freeze: Current public manual at source freeze. Public locator: Technical.

561 MB-1132. Public Services and Procurement Canada, Contract Security Program, Contract Security Manual. Identifier: Effective 13 August 2020. Status at the 16 August 2026 source freeze: Current public manual at source freeze. Public locator: Technical.

562 MB-1140. Public Services and Procurement Canada, Contract Security Program, Work site security requirements. Status at the 16 August 2026 source freeze: Current public guidance at source freeze. Public locator: Technical role: Document safeguarding.

563 MB-1134. Public Services and Procurement Canada, Contract Security Program, Contract Security Manual. Identifier: Effective 13 August 2020. Status at the 16 August 2026 source freeze: Current public manual at source freeze. Public locator: Technical.

564 MB-1132. Public Services and Procurement Canada, Contract Security Program, Contract Security Manual. Identifier: Effective 13 August 2020. Status at the 16 August 2026 source freeze: Current public manual at source freeze. Public locator: Technical.

first-of-type construction and explicit hold points should precede repetitive release.

The correction equation, measured difference and accepted limit should be recorded. A lower-bound result can be useful evidence, but it should not be presented as an exact high-isolation value. Silence on the analyser trace can mean insufficient dynamic range rather than zero transmission. Lifecycle evidence for background-noise correction and dynamic-range limitation should include baseline indicators, maintenance criteria, event triggers and the records required to detect later drift.

Worked example 35.11. Energetic background correction

The total receiving level with the source on is 34.0 dB and the background level is 30.0 dB in one band. Calculate the corrected signal level.

$$L_s = 10\log_{10}\left(10^{34.0/10} - 10^{30.0/10}\right)$$

L_s is corrected transmitted-signal level. The subtraction occurs in linear energy units.

The corrected level is about 31.8 dB, a 2.2 dB correction from the observed total.

A 4 dB separation is marginal for many methods. Uncertainty and method-specific limits must be applied.

35.12 Reverberation decay, absorption area and room correction

Receiving-room decay or absorption is required by several sound-insulation methods because the measured level depends on how rapidly sound energy decays. ISO 3382-2 and ASTM E2235 provide relevant room-decay procedures within their scopes. Decay can vary by frequency, position, source, furnishing, coupled volume and noise floor. [565][566][567][568]

A single reverberation number can hide non-exponential decay, modal behaviour, multiple slopes and changing background. Small or irregular rooms can violate diffuse-field assumptions. Furnishings may improve or reduce apparent isolation quantities depending on the selected normalisation, even though the physical boundary is unchanged. A secure-room assessment of reverberation decay, absorption area and room correction should preserve the distinction between acoustic transfer, non-acoustic security questions and the authority that ultimately decides use.

The plan should specify excitation, positions, decay range, fit quality, interrupted or integrated impulse response method, environmental state, room contents and handling of anomalous decays. The same final room state used for sound-insulation testing should be represented unless the standard specifies otherwise. The design basis for reverberation decay, absorption area and room correction must identify what is fixed, what may vary, who may approve a change and what evidence is required before return to service.

Band decay curves and fit diagnostics should be retained; corrected quantities should identify the reference time or absorption area and sign

565 MB-1134. Public Services and Procurement Canada, Contract Security Program, Contract Security Manual. Identifier: Effective 13 August 2020. Status at the 16 August 2026 source freeze: Current public manual at source freeze. Public locator: Technical.
566 MB-1133. Public Services and Procurement Canada, Contract Security Program, Contract Security Manual. Identifier: Effective 13 August 2020. Status at the 16 August 2026 source freeze: Current public manual at source freeze. Public locator: Technical.
567 MB-1132. Public Services and Procurement Canada, Contract Security Program, Contract Security Manual. Identifier: Effective 13 August 2020. Status at the 16 August 2026 source freeze: Current public manual at source freeze. Public locator: Technical.
568 MB-0394. Canadian Centre for Cyber Security, Direction on the use of voice and audio technology in public-facing services. Status at the 16 August 2026 source freeze: Current public direction at source freeze. Public locator: Technical role: Public-.

convention; room treatment changes made solely to facilitate a test should be disclosed and evaluated against the intended occupied state. A favourable corrected result does not prove that the uncorrected receiving condition supports the operational speech objective; the conclusion drawn from reverberation decay, absorption area and room correction must be no stronger than the measurand, sampling, uncertainty, configuration knowledge and public-source boundary permit.

Worked example 35.12. Sabine absorption estimate

A receiving room has volume V = 90 m3 and measured reverberation time T60 = 0.75 s. Estimate equivalent absorption area using the Sabine relation.

$$A = 0.161\frac{V}{T_{60}}$$

A is equivalent absorption area in square metres, V is room volume in cubic metres and T60 is reverberation time in seconds.

The estimated absorption area is 19.3 m2.

The relation assumes a sufficiently diffuse field and does not capture coupled volumes, non-exponential decay or strong modal effects.

35.13 Vibration measurement, phase, coherence and structural paths

Airborne speech can excite panels, frames, slabs, ducts, pipes and equipment supports. Accelerometers, velocity transducers, laser vibrometers, force hammers and operational reference channels can identify structure-borne participation. The measurement question should distinguish surface motion, transfer mobility, force transmissibility, coherence, phase and radiated acoustic consequence. [569][570][571][572][573]

Sensor mass, mounting stiffness, orientation, cable restraint, magnetic bases, adhesive layers and local curvature affect the result; a high vibration level does not by itself prove dominant acoustic transmission; room pressure can drive a panel strongly while another path still controls the receiving field. Coherence can be reduced by multiple inputs, noise, nonlinearity or time variation; within vibration measurement, phase, coherence and structural paths, the decisive analysis follows the complete source-path-receiver chain and records each interface capable of carrying pressure, force, information or measurement bias.

The structural test plan should map candidate paths, reference sources, coordinate directions, frequency resolution, sensor mounting, calibration, mass loading, time synchronisation and operating states. Controlled source muting, support isolation or force input can improve causal discrimination when safety and service obligations are preserved. The design record for vibration measurement, phase, coherence and structural paths should translate those mechanisms into dimensions, products, tolerances, support conditions, inspection stages and named ownership.

Reports should preserve complex spectra where phase matters, not merely magnitude screenshots. Sensor and reference locations, orientation, mounting and environmental state should be photographed and indexed. Vibration evidence should support a specific transfer hypothesis and should

569 MB-0354. ASTM International, ASTM E336-25a, ASTM E2638-24.
570 MB-0353. ASTM International, ASTM E336-25a.
571 MB-0355. ASTM International, ASTM E336-25a, ASTM E2638-24.
572 MB-0356. ASTM International, ASTM E336-25a, ISO 16283-1:2014.
573 MB-0353. ASTM International, ASTM E336-25a.

not be enlarged into proof of information compromise. Evidence concerning vibration measurement, phase, coherence and structural paths should identify the exact observed unit, method, instrument chain, state, limitations and inference supported.

Worked example 35.13. Acceleration converted to sinusoidal velocity

A narrowband acceleration amplitude is a = 0.020 m/s2 RMS at frequency f = 80 Hz. Estimate the corresponding velocity amplitude for a sinusoid.

$$v = \frac{a}{2\pi f}$$

v is RMS velocity in metres per second, a is RMS acceleration and f is frequency in hertz.

The velocity is about 3.98 x 10^-5 m/s, or 0.0398 mm/s RMS.

The conversion assumes a single sinusoidal component. Broadband integration requires frequency-domain treatment.

35.14 Sound intensity, surface scanning and local radiation

Sound-intensity methods estimate net acoustic energy flow using pressure and particle-velocity information or an approximation derived from a pressure-gradient probe. ISO 9614-1 and related parts define methods for sound-power determination using intensity. In secure-room diagnosis, intensity can also assist localisation of radiating panels, doors, ducts and junctions when its field limitations are respected. [574][575][576][577]

574 MB-1152. Royal Canadian Mounted Police, ASTM E336-25a.
575 MB-1150. Royal Canadian Mounted Police, ASTM E336-25a.
576 MB-1148. Royal Canadian Mounted Police, Guide to the Application of Physical Security Zones. Identifier: GCPSG-015.
577 MB-0357. ASTM International, ASTM E336-25a, ISO 16283-1:2014.

Reactive near fields, insufficient pressure-residual-intensity capability, probe spacing, phase mismatch, airflow, background, scanning speed and surface definition can distort results. Negative local intensity can arise from energy flowing inward or from field complexity. A colourful map is not self-interpreting and should not be mistaken for speech intelligibility. For sound intensity, surface scanning and local radiation, the mechanism must be traced from excitation through materials, supports, openings, controls and adjoining spaces rather than inferred from the trade name of one component.

The plan should define measurement surface, grid or scan path, probe orientation, spacer, frequency range, field indicators, background, stationarity and repeatability. Source and receiver states should remain controlled. Pressure-only scans may be faster but answer a different question from active intensity. Accordingly, sound intensity, surface scanning and local radiation requires a controlled configuration with stable identifiers, coordinated details, access provisions and change triggers that remain usable after handover.

Reports should preserve signed band data, surface area, coordinates, quality indicators, calibration, phase verification and excluded regions; integration should use actual cell areas and should state whether the result is local flux, partial power or a qualitative comparison. A local outward-intensity hot spot identifies energy flow under the test state; it does not identify a covert device or prove that no other path exists; verification of sound intensity, surface scanning and local radiation should combine documentary reconciliation, direct observation and measurement without allowing one evidence class to substitute silently for another.

Worked example 35.14. Sound power from uniform normal intensity

A mapped panel area is S = 2.4 m2 and the area-averaged outward normal intensity is I_n = 2.0 x 10^-5 W/m2 in a band. Estimate radiated band power.

$$W = I_n S$$

W is acoustic power in watts, I_n is normal active intensity and S is mapped area.

The estimated power is 4.8 x 10^-5 W.

The example assumes uniform stationary intensity and valid probe field conditions. Real maps require cell-by-cell integration.

35.15 Façade, exterior and weather-dependent measurement

Exterior boundaries introduce wind, traffic, aircraft, rain, temperature gradients, ground reflection, façade geometry and source-access constraints. ASTM E966 provides guidance for field airborne sound attenuation of façades and façade elements. Outdoor-indoor quantities and local leakage studies should be selected according to the authorised question rather than borrowed from an interior room-pair method without justification. [578][579][580][581]

A façade can transmit through glass, frames, spandrels, vents, drainage cavities, mullions, roof interfaces and structural anchors; source geometry and incidence angle matter; wind noise can dominate microphone self-noise, while temperature and pressure can alter seals; exterior access may

578 MB-1086. National Research Council Canada, ASTM E336-25a.
579 MB-1085. National Research Council Canada, Codes Canada, National Model Codes and public code-development information. Status at the 16 August 2026 source freeze: Current public code information at source freeze. Public locator: Technical role: Buil.
580 MB-1139. Public Services and Procurement Canada, ASTM E336-25a.
581 MB-0359. ASTM International, ASTM E2638-24, ISO 3382-2:2008.

place practical listener positions near roof, balcony or maintenance routes. The engineering model for façade, exterior and weather-dependent measurement should identify which physical variables change with frequency, operating state, loading, access, maintenance and environmental condition.

The plan should record source type and location, façade area, angle, distance, weather, ground, traffic, building systems, openings, pressure, interior absorption and accessible receiver positions. Where an artificial source is used, safety and neighbour effects should be controlled. Repeated measurements may be needed across credible weather states. Design development should assign every consequential interface in façade, exterior and weather-dependent measurement to a responsible discipline and should resolve acoustic, structural, fire, accessibility and service obligations together.

Reports should distinguish façade element evidence, whole-room interior response and operational speech consequences. Weather exclusions and limiting bands should be conspicuous. One calm-day result cannot establish performance during high wind, driving rain, seasonal seal change or altered exterior access. The acceptance record for façade, exterior and weather-dependent measurement should preserve raw data, calibration, photographs, dimensions, processing and the decision rule needed for later reproduction.

Worked example 35.15. Free-field distance change screen

A compact source is moved from 5 m to 10 m from a façade under an ideal free-field point-source assumption. Estimate the level change.

$$\Delta L = -20 \log_{10}\left(\frac{10}{5}\right)$$

Delta L is the ideal level change and the ratio contains final and initial source distances.

The ideal decrease is approximately 6.0 dB.

Façade reflections, ground, source directivity, atmospheric gradients and extended-source behaviour can invalidate the simple relation.

35.16 Masking, objective speech privacy and intelligibility metrics

Speech privacy depends on transmitted speech, receiving background, listener position, source effort, language, familiarity, duration and access. ASTM E2638-24 provides an objective closed-room privacy method for unaided listeners and does not prescribe universal adequacy criteria. IEC 60268-16:2020 with Corrigendum 1:2025 addresses objective speech intelligibility through STI-family methods within its scope. ASTM E1573-22 addresses measurement and reporting of masking levels. [582][583][584][585][586]

Masking raises receiving background but does not repair the boundary; spatial non-uniformity, failed emitters, controller changes, zoning, alarms and quiet states can expose local positions; masking inside the source room can induce a Lombard response and increase talker level. Speech metrics

582 MB-0358. ASTM International, ASTM E2638-24.
583 MB-1137. Public Services and Procurement Canada, Contract Security Program, Information technology security requirements. Status at the 16 August 2026 source freeze: Current public guidance at source freeze. Public locator: Technical role: Authority.
584 MB-0393. Canadian Centre for Cyber Security, Communications security public information. Status at the 16 August 2026 source freeze: Current public information at source freeze. Public locator: Technical role: COMSEC governance.
585 MB-0392. Canadian Centre for Cyber Security, Communications security public information. Status at the 16 August 2026 source freeze: Current public information at source freeze. Public locator: Technical role: COMSEC governance.
586 MB-0396. Canadian Centre for Cyber Security, Emission Security Guidance. Identifier: ITSG-11A. Status at the 16 August 2026 source freeze: Protected publication.

based on average or modelled signals may not capture short consequential tokens, repeated access or assisted processing outside scope; a credible treatment of masking, objective speech privacy and intelligibility metrics distinguishes direct transmission, structural coupling, connected air paths, regenerated sound and observational uncertainty before selecting a remedy.

Commissioning should map masking spectra and levels, document controller and software state, include quiet and failure modes, and measure source behaviour where Lombard effects are credible. Objective privacy or STI tests should use the correct source, level, spectrum, modulation, positions and method limitations. The project documents should make masking, objective speech privacy and intelligibility metrics buildable and inspectable by defining geometry, sequence, acceptable variation, substitute evidence and the point at which concealment is prohibited.

The report should state listener assumptions, background state, source effort, language or signal, duration, positions and authority criteria. It should avoid the absolute statement that a room is eavesdrop-proof. Speech not intelligible under one stated test does not establish the absence of audible fragments, recordings or electronic collection. A favourable observation of masking, objective speech privacy and intelligibility metrics remains bounded to the inspected population and measured state, while unseen conditions and untested modes associated with masking, objective speech privacy and intelligibility metrics remain explicit limitations.

Worked example 35.16. Net benefit after Lombard response

Receiving masking is increased by 5 dB. Measured talker output inside the room rises by 2 dB under the new condition. Estimate the simple net receiving margin change for an unchanged transfer path.

$$\Delta M = 5 - 2 = 3\,dB$$

Delta M is the simple change in level margin. It is not an STI or recognition probability.

The nominal net benefit is about 3 dB, not 5 dB.

Spectrum, modulation, source orientation, listener position and speech behaviour remain relevant.

35.17 Measurement uncertainty, covariance and model adequacy

Measurement uncertainty describes dispersion associated with the measured quantity and its model. ISO 12999-1:2020 provides procedures and typical values for building sound-insulation uncertainty. JCGM 100:2008, its 2026 amendment, JCGM GUM-1:2023, JCGM GUM-6:2020 and JCGM 106:2012 provide broader measurement-model and conformity guidance.

Configuration uncertainty and model discrepancy should remain separate unless explicitly formalised. [587][588][589][590][591][592][593]

Uncertainty contributors can include calibration, repeatability, position, source stability, background, reverberation, room volume, area, environmental state, filter response, data processing and classification. Shared calibration or geometry creates covariance in before-and-after comparisons. Nonlinear classification and censored bands may require simulation or sensitivity analysis rather than a symmetric attachment to one integer. Analysis of measurement uncertainty, covariance and model adequacy begins by mapping the actual configuration, because small differences in geometry, restraint, continuity or software state can reverse the dominant path.

The uncertainty budget should identify input quantities, estimates, distributions, standard uncertainties, sensitivity coefficients, covariance, degrees of freedom where used, combined uncertainty, coverage factor and expanded uncertainty. It should also identify omitted mechanisms and configuration unknowns outside the numerical budget. A robust

587 MB-0391. Canadian Centre for Cyber Security, Canadian Industrial TEMPEST Program. Identifier: CITP. Status at the 16 August 2026 source freeze: Current public programme description at source freeze. Public locator: Technical role: TEMPEST equipment.
588 MB-0390. Canadian Centre for Cyber Security, Canadian Industrial TEMPEST Program. Identifier: CITP. Status at the 16 August 2026 source freeze: Current public programme description at source freeze. Public locator: Technical role: TEMPEST equipment.
589 MB-0399. Canadian Centre for Cyber Security, Protecting specified information in non-Government of Canada systems and organizations. Identifier: ITSP.10.171. Status at the 16 August 2026 source freeze: Current.
590 MB-1191. Treasury Board of Canada Secretariat, Directive on Security Management. Identifier: Policy instrument 32611. Status at the 16 August 2026 source freeze: Current public directive and mandatory procedures. Public locator: Technical role: Depa.
591 MB-1189. Treasury Board of Canada Secretariat, Directive on Security Management. Identifier: Policy instrument 32611. Status at the 16 August 2026 source freeze: Current public directive and mandatory procedures. Public locator: Technical role: Depa.
592 MB-1197. Treasury Board of Canada Secretariat, Directive on Security Management. Identifier: Policy instrument 32611. Status at the 16 August 2026 source freeze: Current public directive and mandatory procedures. Public locator: Technical role: Depa.
593 MB-1192. Treasury Board of Canada Secretariat, ISO 19650-5:2020.

specification for measurement uncertainty, covariance and model adequacy combines performance language with prescriptive detail wherever the mechanism cannot be verified from a final single-number test.

Sensitivity analysis should show which inputs control the result and which additional evidence would matter. A small instrument uncertainty does not justify a confident conclusion where the room state or path model is uncertain. One precise number cannot absorb every unknown without a defensible measurement model. Testing of measurement uncertainty, covariance and model adequacy should report band data and operating conditions before any summary rating, so that background, flanking, drift and method scope can be examined.

Worked example 35.17. Combined uncertainty with positive covariance

Two standard uncertainty contributions are u1 = 0.8 dB and u2 = 0.6 dB with correlation coefficient r = 0.50 and equal positive sensitivity signs. Calculate their combined standard contribution.

$$u_c = \sqrt{u_1^2 + u_2^2 + 2\, r\, u_1\, u_2}$$

u_c is combined standard uncertainty and r represents correlation.

The combined value is about 1.22 dB. Assuming independence would give only 1.00 dB.

A full budget may contain many contributors, non-normal distributions and nonlinear terms.

35.18 Decision rules, guard bands and acceptance risk

Conformity decisions require a rule agreed before testing. The rule may compare the measured estimate directly with a limit, apply a guard band based on expanded uncertainty, use a lower confidence bound, require band-by-band margins, or combine numerical results with configuration evidence. JCGM 106 explains the role of uncertainty in conformity assessment but does not select the project risk policy. [594][595][596][597]

Producer and consumer risks are not necessarily symmetrical; a false pass can expose protected information, while a false fail can impose demolition, delay and cost; high-consequence projects may require stronger guard bands, repeated tests, independent review or conditional operations. A positive numerical margin does not resolve missed concealed-work evidence or untested states; the controlling behaviour of decision rules, guard bands and acceptance risk is system dependent and cannot be reduced to one catalogue value when adjacent construction and services participate in the measured response.

The contract and test plan should define direction of better performance, limit, uncertainty quantity, coverage basis, rounding, treatment of limited bands, retest rules, witness roles, conditional acceptance and authority. The laboratory or consultant should apply the rule but should not invent the authority criterion after seeing the result. Procurement and submittal review should preserve the tested or approved identity of decision rules, guard bands and acceptance risk, including the features whose alteration would invalidate comparison with the supporting evidence.

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594 MB-1189. Treasury Board of Canada Secretariat, Directive on Security Management. Identifier: Policy instrument 32611. Status at the 16 August 2026 source freeze: Current public directive and mandatory procedures. Public locator: Technical role: Depa.

595 MB-1141. Public Services and Procurement Canada, ISO 19650-5:2020.

596 MB-1142. Public Services and Procurement Canada, Contract Security Program, Work site security requirements. Status at the 16 August 2026 source freeze: Current public guidance at source freeze. Public locator: Technical role: Document safeguarding.

597 MB-1138. Public Services and Procurement Canada, Contract Security Program, Work site security requirements. Status at the 16 August 2026 source freeze: Current public guidance at source freeze. Public locator: Technical role: Document safeguarding.

Reports should show the estimate, uncertainty, guarded quantity, limit and disposition as separate fields. Where the authority accepts residual risk, the decision should identify conditions and expiry or review triggers. Passing a pre-agreed measurement rule is not the same as governmental accreditation or universal security. Where decision rules, guard bands and acceptance risk is evaluated by intervention, the record should describe collateral changes and restoration duties before attributing the observed difference to one mechanism.

Worked example 35.18. Guarded higher-is-better acceptance

The measured result is y = 52.4 dB with expanded uncertainty U = 1.4 dB. The project limit is L = 50 dB and the pre-agreed rule requires y - U to equal or exceed L.

$$y_g = y - U = 52.4 - 1.4 = 51.0\, dB$$

y_g is the guarded result, y is the estimate, U is expanded uncertainty and L is the limit.

The guarded value is 51.0 dB, so the numerical rule passes by 1.0 dB.

Configuration uncertainty, untested states and authority conditions remain separate.

35.19 Raw data, metadata, processing and digital integrity

A measurement is reproducible only when its native data, configuration and processing can be recovered. Screenshots and printed summaries are insufficient. The record should preserve raw waveforms or spectra where appropriate, analyser project files, calibration data, position and state logs, photographs, scripts, software and firmware versions, exported tables, reports and revision history. [598][599][600][601]

Processing choices such as window, overlap, averaging, filter implementation, weighting, decay fit, excluded samples, background correction and classification can materially change results. Proprietary file formats and cloud portals can become inaccessible. Time offsets can create false causal sequences among acoustic, vibration, access and control-system logs. For the question addressed in section 35.19, raw data, metadata, processing and digital integrity is examined as a time-varying network whose inputs, boundaries and receiver conditions must all remain explicit.

The data-management plan should assign stable identifiers, original filenames, controlled filenames, time source, access, transfer, storage, backup, retention, conversion, redaction, legal or security hold and disposal. Derived records should link to originals and scripts. Open or durable derivatives should supplement, not overwrite, native files. For raw data, metadata, processing and digital integrity, the room data sheet and requirement matrix should state source states, adjoining access, operating modes, lifecycle duties and the accepting authority.

SHA-256 digests can make byte-level alteration detectable when manifests are preserved; they do not prove calibration, placement, authorship or interpretation; a changed hash requires investigation, not automatic accusation; integrity, provenance and technical validity are separate

598 MB-1088. National Research Council Canada, ISO 19650-3:2020.
599 MB-1087. National Research Council Canada, ASTM E2638-24.
600 MB-1085. National Research Council Canada, Codes Canada, National Model Codes and public code-development information. Status at the 16 August 2026 source freeze: Current public code information at source freeze. Public locator: Technical role: Buil.
601 MB-0355. ASTM International, ASTM E336-25a, ASTM E2638-24.

propositions. The dossier for raw data, metadata, processing and digital integrity should distinguish as-designed, as-submitted, as-installed, as-tested, as-authorised and as-operated states.

Worked example 35.19. Sample count and record duration

A waveform is sampled at 48,000 samples per second for 180 seconds on four synchronous channels. Calculate the total scalar sample count before headers or metadata.

$$N = 48{,}000 \times 180 \times 4$$

N is the number of scalar samples across all channels.

The acquisition contains 34,560,000 scalar samples.

File size depends on bit depth, encoding, compression and metadata. Sample count does not prove synchronisation or validity.

35.20 Time-base synchronisation, multichannel phase, latency, and trigger architecture

Multichannel measurement is only as coherent as its time base. Simultaneous pressure, intensity, acceleration, tachometer, airflow, access-control, controller, and source-reference channels may appear aligned because their files share a clock display, yet material offsets can arise from independent analogue-to-digital converters, wireless transmission, operating-system buffering, network latency, sample-rate drift, filter group delay, and unsynchronised logging. A phase or causation conclusion therefore requires more than nominal timestamps. The measurement plan should identify the master clock, sample clock, trigger, channel latency, anti-alias filters, block size, transfer method, and the uncertainty of time alignment.[602][603][604][605]

A shared chassis with one sample clock ordinarily provides stronger channel synchronisation than separate instruments that begin on a common command. Separate recorders can still be used when their clocks are characterised, a common reference signal is recorded, and drift is corrected transparently. Global navigation timing, precision time protocol, network time protocol, or a manual clap can serve different purposes and have very different uncertainty. The report should not call channels synchronous merely because their displayed start times match to the nearest second.

Latency should be measured end to end; a digital audio processor can add frame delay; a networked sensor can buffer and transmit blocks; a vibration conditioner can introduce high-pass phase shift. An analyser can apply window centring or overlap. If one channel is used as a causal reference, the known delays should be removed or carried into the phase and coherence interpretation. A stable unknown delay produces a frequency-dependent phase ramp. Variable latency broadens cross-correlation and can reduce coherence even when the physical relation is strong.

Trigger architecture should match the event. Continuous tests may use a shared hardware trigger; intermittent door, pump, damper, or conferencing events may require pre-trigger memory so that onset is preserved; very short impulses require adequate sample rate, anti-alias protection, and dynamic range. Long tests require drift checks. The record should retain raw

602 MB-0811. ISO/IEC 17025:2017, JCGM 100:2008.
603 MB-0810. ISO/IEC 17025:2017.
604 MB-1204. Treasury Board of Canada Secretariat, JCGM 106:2012.
605 MB-1194. Treasury Board of Canada Secretariat, ISO 19650-3:2020.

trigger channels and not only the extracted event times; a derived event list can be regenerated; a discarded trigger waveform cannot.

The time-alignment uncertainty can be expressed as an equivalent phase uncertainty. For a sinusoidal component of frequency f and timing uncertainty u_t, the phase uncertainty in radians is approximately

$$u_\phi = 2\pi f u_t .$$

Here u_phi is standard phase uncertainty, f is frequency in hertz, and u_t is standard timing uncertainty in seconds. The relation is a first-order screen. Filter phase, source nonstationarity, clock drift, and spatial separation remain separate contributors.

Worked example 35.20. Timing error converted to phase error

Two channels have relative timing uncertainty u_t = 80 microseconds. At f = 1,000 Hz,

$$u_\phi = 2\pi (1000) \left(80 \times 10^{-6}\right) = 0.503\, rad = 28.8\, degrees .$$

The timing uncertainty is too large for a confident 1 kHz phase comparison, even though it may be acceptable for event ordering at a coarser scale. At 100 Hz the same uncertainty corresponds to 2.88 degrees. Phase suitability is frequency dependent.

35.21 Transfer functions, system identification, coherence, mobility, and reciprocity

Secure-room diagnosis often requires a relation between input and response rather than a level at one position. Frequency-response functions can connect loudspeaker reference to receiving pressure, shaker force to structural velocity, duct pressure to terminal response, or equipment force to slab acceleration. The input, output, estimator, averaging, window, excitation, and field conditions must be defined. A transfer function is not an intrinsic property when the system is nonlinear, time varying, or affected by unmeasured inputs.[606][607][608][609][610]

For an input x(t) and output y(t), the common H1 estimator is

$$H_1(f)=\frac{G_{yx}(f)}{G_{xx}(f)},$$

where H1 is the estimated frequency-response function, G_yx is the cross-power spectral density between output and input, and G_xx is the input auto-power spectral density. H1 tends to reduce bias from uncorrelated output noise when input noise is small. The H2 estimator uses G_yy/G_xy and has different bias. The estimator should be selected for the actual noise model rather than by software default.

Magnitude-squared coherence is

$$\gamma^2(f)=\frac{\left|G_{xy}(f)\right|^2}{G_{xx}(f)G_{yy}(f)}.$$

The value ranges from zero to one under the estimator assumptions. Low coherence can indicate unrelated noise, nonlinear response, time variation, leakage between spectral lines, insufficient averaging, source drift, timing error, or multiple independent inputs. High coherence supports a consistent linear relation under the measured state. It does not prove that the chosen

606 MB-1189. Treasury Board of Canada Secretariat, Directive on Security Management. Identifier: Policy instrument 32611. Status at the 16 August 2026 source freeze: Current public directive and mandatory procedures. Public locator: Technical role: Depa.
607 MB-1210. Treasury Board of Canada Secretariat, ISO 19650-3:2020.
608 MB-1135. Public Services and Procurement Canada, Contract Security Program, Contract Security Manual. Identifier: Effective 13 August 2020. Status at the 16 August 2026 source freeze: Current public manual at source freeze. Public locator: Technical.
609 MB-1132. Public Services and Procurement Canada, Contract Security Program, Contract Security Manual. Identifier: Effective 13 August 2020. Status at the 16 August 2026 source freeze: Current public manual at source freeze. Public locator: Technical.
610 MB-0395. Canadian Centre for Cyber Security, Emission Security Guidance. Identifier: ITSG-11A. Status at the 16 August 2026 source freeze: Protected publication.

input is the sole cause, nor does it prove speech intelligibility or information compromise.

Structural mobility relates velocity to force; accelerance relates acceleration to force; dynamic stiffness relates force to displacement. These quantities carry different frequency powers and units; the report should preserve the selected quantity, transducer mounting, force measurement, coordinate direction, sign, and reference; reciprocal source and receiver interchange can be useful in linear passive systems, but boundaries, damping, airflow, active controls, and operational state can limit reciprocity. A convenient reciprocal test should not be substituted for the required direction without justification.

System identification should include model checks. The team can vary source position, level, direction, support condition, or operating state and ask whether the response changes as the proposed mechanism predicts; a slab path should show coherent structural response and appropriate changes when plant isolation changes. A duct path should respond to branch muting or terminal treatment; a door gap should respond to local sealing; a model that can explain every result after the fact is not discriminating.

Worked example 35.21. Coherence and transfer-magnitude screen

At 125 Hz, the source-reference auto-spectrum is G_xx = 4.0 units, the receiving auto-spectrum is G_yy = 1.0 unit, and the magnitude of the cross-spectrum is |G_xy| = 1.6 units. Then

$$\gamma^2 = \frac{1.6^2}{4.0 \times 1.0} = 0.64 .$$

The coherence is moderate, not conclusive. The H1 magnitude is |H1| = 1.6/4.0 = 0.40 in the corresponding output-per-input units. Additional averaging, examination of other inputs, timing verification, and state contrast are warranted before attributing the response to one path.

35.22 Nonstationary sources, intermittent events, percentile statistics, and time-frequency analysis

Many consequential room events are intermittent. A door opens for three seconds, a remote conference system raises gain, a pump cycles, a damper moves, a cleaner removes a ceiling tile, or speech occurs during an unusually quiet night state. Long energetic averages can conceal these intervals. The test plan should therefore define whether the decision concerns steady performance, maximum short-term exposure, event rate, percentile level, cumulative energy, modulation, intelligibility, or the recovery of distinctive tokens. The statistic must match the information consequence and operating state.[611][612][613][614]

Event detection should use a documented rule; threshold crossing alone can split one event into many fragments or merge unrelated events; hysteresis, minimum duration, hold time, spectral content, reference-channel coincidence, and pre-trigger/post-trigger windows can improve classification. The raw record should be retained so that the event list can be audited; manual annotations are valuable when they identify door

611 MB-1202. Treasury Board of Canada Secretariat, Policy on Government Security. Identifier: Policy instrument 16578. Status at the 16 August 2026 source freeze: Current.
612 MB-1200. Treasury Board of Canada Secretariat, Policy on Government Security. Identifier: Policy instrument 16578. Status at the 16 August 2026 source freeze: Current.
613 MB-1196. Treasury Board of Canada Secretariat, Directive on Security Management. Identifier: Policy instrument 32611. Status at the 16 August 2026 source freeze: Current public directive and mandatory procedures. Public locator: Technical role: Depa.
614 MB-1190. Treasury Board of Canada Secretariat, Directive on Security Management. Identifier: Policy instrument 32611. Status at the 16 August 2026 source freeze: Current public directive and mandatory procedures. Public locator: Technical role: Depa.

operation, equipment state, occupancy, or unusual noise, but they should not replace objective channels where precise timing matters.

Percentile statistics such as L10, L50, and L90 describe the level exceeded for stated percentages of time; they are useful for variable backgrounds but do not identify the source or preserve event sequence; an L90 quiet-state estimate can be inappropriate when the receiver actually has lawful access during the lower one per cent of the distribution. Similarly, a maximum detector can overreact to an unrelated impact; the report should show the distribution, time history, and relevant event examples rather than presenting one percentile as a universal background.

Short-time Fourier transforms, wavelets, order tracking, and modulation analysis can reveal changing frequency content; their resolution is governed by window length, overlap, taper, sample rate, and algorithm; longer windows improve frequency resolution while smearing onset; shorter windows improve time localisation while broadening spectral lines. Zero padding interpolates the display but does not create new resolution. A colourful spectrogram is an analytical representation whose parameters and dynamic range must be preserved.

For a record divided into N events, event rate can be screened as

$$\lambda = \frac{N}{T},$$

where lambda is events per unit time, N is the counted events, and T is observation duration. A Poisson model may be inappropriate when events cluster by occupancy, schedule, or common cause. The rate is descriptive unless the generating process is justified.

Worked example 35.22. Short event hidden by equivalent level

A five-second conferencing burst produces 45 dB at the receiving position during a thirty-minute period whose remaining level is 24 dB. The period equivalent level is

$$L_{eq} = 10\log_{10}\left[\frac{5\left(10^{45/10}\right) + 1795\left(10^{24/10}\right)}{1800}\right) = 25.3\,dB.$$

The 25.3 dB average conceals the 45 dB event. The event waveform, source state, listener access, and speech consequence must be reported separately.

35.23 Low-frequency and infrasonic measurement, sensor self-noise, and environmental contamination

Low-frequency measurement becomes difficult because room modes, building motion, wind, pressure drift, microphone venting, sensor self-noise, traffic, plant, and structural coupling can dominate. A nominal analyser range down to 1 Hz does not establish useful field capability at 1 Hz. The complete chain includes transducer response, preamplifier noise, high-pass filters, pressure equalisation, mounting, cable motion, digitiser drift, window length, record duration, and environmental state. The project should define the lowest frequency at which amplitude and phase support the intended inference.[615][616][617][618][619]

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615 MB-1189. Treasury Board of Canada Secretariat, Directive on Security Management. Identifier: Policy instrument 32611. Status at the 16 August 2026 source freeze: Current public directive and mandatory procedures. Public locator: Technical role: Depa.
616 MB-1153. Royal Canadian Mounted Police, Guide to the Application of Physical Security Zones. Identifier: GCPSG-015.
617 MB-1207. Treasury Board of Canada Secretariat, Policy on Government Security. Identifier: Policy instrument 16578. Status at the 16 August 2026 source freeze: Current.
618 MB-1293. U.S. Department of State, 12 FAM 010, ICD 705.
619 MB-1293. U.S. Department of State, 12 FAM 010, ICD 705.

Microphones designed for audible sound can exhibit increased noise and environmental sensitivity at very low frequencies; pressure, free-field, and random-incidence responses are not interchangeable; windscreens reduce some turbulence noise but do not remove pressure fluctuations. Flush mounting can change response. Accelerometers can suffer thermal drift, base strain, cable triboelectric noise, and mass loading; velocity transducers and geophones have their own resonance and orientation limits. A low-frequency campaign should select sensors by noise floor, sensitivity, phase, environmental tolerance, and mounting, not by catalogue bandwidth alone.

Record duration controls resolution. A one-third-octave result near 10 Hz can be calculated from a relatively short record, but stable estimation of discrete components, modulation, coherence, or sub-hertz behaviour may require much longer observation. Stationarity should be tested rather than assumed. Plant cycling, traffic, wind, tides, weather fronts, and occupancy can produce trends over minutes or hours. The report should identify whether the result is a snapshot, representative operating sample, or long-duration distribution.

Environmental reference channels are valuable. Outdoor wind and pressure, indoor barometric pressure, temperature, humidity, plant speed, electrical frequency, and nearby vibration can help distinguish room transfer from common external excitation. Reference placement must avoid creating the same path being investigated. A sensor on the wall and a sensor on the floor may both respond to a building mode without identifying causation. Phase, spatial pattern, operating-state contrast, and controlled intervention strengthen interpretation.

The minimum detectable level in a band can be screened by combining sensor self-noise and environmental background energetically. Where L_n is instrument-chain noise and L_b is environmental background, the combined floor is

$$L_f = 10\log_{10}\left(10^{L_n/10} + 10^{L_b/10}\right).$$

The levels must represent compatible quantities and bandwidths. The result does not include drift, distortion, or model error.

Worked example 35.23. Combined low-frequency floor

At 8 Hz, the sensor-chain equivalent noise is 23 dB in the analysis band and environmental background is 27 dB. The combined floor is

$$L_f = 10\log_{10}\left(10^{2.3} + 10^{2.7}\right) = 28.5\,dB.$$

A receiving signal of 29 dB has insufficient margin for confident subtraction or phase analysis. A quieter sensor alone would not solve the environmental limitation.

35.24 Airflow, pressure, air-leakage diagnostics, and the limits of proxy measurements

Air leakage and sound leakage can share openings, but they are not equivalent quantities; fan pressurisation, component air-leakage tests, smoke, fog, tracer gas, anemometry, and pressure mapping can reveal discontinuities or compare repairs; they do not establish transmission loss, speech privacy, or the frequency-dependent impedance of the path. A narrow tortuous crack can pass measurable air yet attenuate sound differently from a short open conduit; a porous wall can radiate through distributed flow; a duct path can carry sound under negligible net air leakage.[620][621][622]

Pressure-assisted diagnostics should define the zone, imposed pressure, baseline leakage, temperature, wind, doors, dampers, drains, traps, vents, and connected spaces. The imposed pressure can move seals, close or open cracks, alter door contact, or drive air through paths that do not experience the same differential in operation. Testing should be proportionate to the construction and should not damage firestop, seals, historic fabric, or sensitive equipment. Safety and authority approval are required before pressurising controlled rooms or connected systems.

Smoke and fog are qualitative. Particle size, buoyancy, illumination, source volume, airflow, deposition, visibility, and detection threshold affect observation. Tracer gas can quantify exchange under a defined mixing model but requires controlled release, background, sampling, and health review. Acoustic source methods can also locate leaks, yet they answer an acoustic question and depend on field geometry, source spectrum, and receiver sensitivity. Agreement among pressure, visual, and acoustic evidence can support a path hypothesis more strongly than any one method.

Operational pressure deserves measurement because HVAC and door control can alter leakage. Differential pressure should be recorded with traceable sensors and adequate resolution, including sign, reference, tubing, averaging, and transient response. A door that seals under positive pressure can leak under negative pressure. A smoke-control mode can

620 MB-0918. International Organization for Standardization, ISO 19650-5:2020, NIST SP 800-37.
621 MB-0915. International Organization for Standardization, ISO 19650-5:2020.
622 MB-1278. U.S. Department of State, 12 FAM 390.

reverse flow. The commissioning matrix should include credible pressure states rather than one comfortable daytime condition.

For a simple power-law fan-pressurisation model,

$$Q = C(\Delta p)^n,$$

where Q is airflow, C is a flow coefficient, delta p is pressure difference, and n is an empirical exponent. The model describes air movement under the test conditions. It does not convert directly to acoustic transmission.

Worked example 35.24. Repair comparison under a pressure-flow model

Before repair, a zone has Q1 = 420 cubic metres per hour at 50 Pa; after repair, Q2 = 290 cubic metres per hour at the same pressure and comparable environmental state; the reduction is 31 per cent; the result supports improved air tightness. A separate acoustic test is still required to determine whether the repaired paths controlled the relevant speech bands.

35.25 Borescope, thermal, optical, ultrasonic, and other auxiliary non-destructive evidence

Auxiliary methods can narrow hypotheses and reduce unnecessary opening. A borescope can observe cavity contact, missing insulation, frame anchors, service routing, grout void indications, or displaced seals through a controlled access point; thermography can reveal temperature patterns associated with air movement, moisture, missing insulation, or structural continuity; optical methods can record contact, displacement, crack width, or vibration. Ultrasonic and impact methods can support material or bond assessment; none of these methods should be represented as a direct substitute for the acoustic quantity unless a validated relation exists.[623][624][625]

Borescope evidence is constrained by field of view, lighting, focus, scale, access angle, hidden surfaces, and the disturbance caused by drilling. The access opening should be selected from the hypothesis, documented before and after, and restored to every relevant fire, acoustic, moisture, structural, and finish requirement. The absence of a visible bridge within a narrow field does not prove the entire cavity is clear. Images should retain orientation, location, date, device, and explanatory context.

Thermography requires control of emissivity, reflected temperature, distance, atmosphere, focus, thermal transients, solar loading, wind, and indoor-outdoor difference; a bright or dark pattern is not self-interpreting; metal studs, pipes, moisture, air leakage, and surface finish can create similar signatures. Thermal evidence becomes stronger when the pattern changes under controlled pressure, HVAC state, or time and agrees with drawings or local acoustic response; it remains inferential until the physical condition is observed or otherwise corroborated.

Optical displacement and laser vibrometry can measure motion without adding sensor mass, but surface reflectivity, angle, speckle, range, line of sight, and reference stability matter. Contact accelerometers may be preferable in some locations and harmful in others. Ultrasonic leak detectors can respond to turbulent flow or high-frequency sources but cannot establish lower-frequency speech transfer. The method should be selected for the mechanism and reported with its scope.

623 MB-1288. U.S. Department of State, 12 FAM 310, 32 CFR Part 117.
624 MB-1287. U.S. Department of State, 12 FAM 310.
625 MB-1295. U.S. Department of State, 12 FAM 010.

Competence and safety are part of method validity. Work near live electrical systems, pressurised pipes, fire protection, hazardous materials, rotating plant, fragile heritage fabric, or controlled equipment may require specialists and permits. A technically interesting image obtained through an unauthorised opening can create greater risk than the uncertainty it resolves.

Worked example 35.25. Triangulated auxiliary diagnosis

A local 2 kHz acoustic hot spot appears near a wall head; thermography under a modest authorised pressure difference shows a narrow temperature anomaly at the same coordinate; a borescope through an approved access point observes a discontinuous backing material behind the joint. The three methods support an air-path mechanism; the project still records each method separately and confirms the repair with the controlling field acoustic test.

35.26 Software, scripts, algorithm validation, numerical precision, and audit trails

Modern measurement depends on software from sensor firmware to final report. The technical record should identify instrument firmware, analyser version, filter implementation, calibration database, project settings, export routine, scripts, libraries, operating system, and any manual edits. A result that cannot be reproduced outside a transient vendor project file is fragile.

Native files should be preserved alongside open or durable exports and the code used for material calculations.[626][627][628][629][630]

Algorithm validation should use known inputs. Energetic averaging can be checked against hand calculations; fractional-octave filters can be checked with tones and broadband signals; background correction can be checked at boundary cases; reverberation fits can be compared across decay ranges. Classification can be checked against published examples. Time alignment can be checked with a common impulse. A software package carrying a respected name can still be misconfigured, and a correct algorithm can be applied to the wrong data column.

Numerical precision should be controlled. Intermediate calculations may retain more digits than the final report, but the displayed result should reflect measurement resolution and uncertainty; premature rounding can alter classifications or guarded decisions; excessive digits can imply false certainty; units should be explicit in data fields, not embedded only in column titles that disappear during export. Decimal separators, date formats, time zones, and character encoding should be standardised for exchange.

Scripts should be version controlled and should record inputs, outputs, parameters, exceptions, and software dependencies; manual removal of samples, changed frequency limits, or altered correction rules should produce a new run record; hashes can link code and data to the report, but

626 MB-0382. Cabinet Office, 12 FAM 010.
627 MB-0380. Cabinet Office, Government Security Classifications Policy. Identifier: Government Security Classifications Policy. Status at the 16 August 2026 source freeze: Current public classification policy at source freeze. Public locator: Technical.
628 MB-0439. 32 CFR Part 117, 12 FAM 310.
629 MB-1270. U.S. Department of State, 12 FAM 360, 12 FAM 390.
630 MB-1268. U.S. Department of State, 12 FAM 360.

a hash cannot demonstrate correctness. Independent review should examine logic, edge cases, and representative calculations; for consequential results, a second implementation or hand calculation provides useful corroboration.

Automated report generation can reduce transcription error but can also propagate a wrong label, stale criterion, or hidden default across hundreds of tables. Templates should be tested after software updates. The release process should compare generated tables with source data and should check that omitted or limited bands remain visibly marked. A blank cell must not be interpreted silently as zero or pass.

Worked example 35.26. Rounding changes a guard-band decision

A guarded result before rounding is 49.96 dB against a 50.00 dB limit. Rounding the estimate and uncertainty separately to one decimal place produces 50.0 dB and an apparent pass, while the unrounded rule fails by 0.04 dB. The decision procedure should specify calculation precision and round only the reported display after the disposition is determined.

35.27 Interlaboratory reproducibility, proficiency testing, method validation, and comparison campaigns

Repeatability describes variation under closely similar conditions. Reproducibility includes changed teams, instruments, laboratories, days, or implementations. Secure-room programmes need both concepts because a result may be stable within one test team yet shift materially when another team applies the method. Differences can arise from source positions, microphone paths, room averaging, decay fitting, background correction, door operation, software, environmental state, and judgement about excluded data.[631][632][633][634]

A comparison campaign should define the measurand and preserve the same room state as far as practicable; blind or partially blind analysis can reveal software and interpretation differences; shared raw data can separate acquisition from processing; shared reference artefacts can compare instrument chains. Repeated physical tests can compare the entire method. The campaign should not use one laboratory as unquestioned truth unless its reference status and uncertainty are justified.

ISO/IEC 17025 addresses laboratory competence, impartiality, methods, validation, traceability, uncertainty, records, and reporting. Accreditation scope should be examined at the method and quantity level. A laboratory accredited for ordinary building acoustics is not automatically competent for every low-frequency, speech-security, vibration, intensity, or forensic inference. Conversely, a competent specialist can provide valuable diagnostic evidence outside an accreditation scope when the status and limitation are stated honestly.

Method validation is required when a standard method is modified or a novel method is used; validation should address selectivity, range, sensitivity, bias, precision, robustness, uncertainty, data integrity, and intended decision; diagnostic methods can be fit for localisation without being fit for contractual classification. A project-specific speech test can be useful without being represented as an international standard; the report

631 MB-1272. U.S. Department of State, 12 FAM 350, ICD 705.
632 MB-0916. International Organization for Standardization, ISO 19650-5:2020.
633 MB-0915. International Organization for Standardization, ISO 19650-5:2020.
634 MB-0352. ASTM International, ASTM E336-25a, ASTM E2638-24.

should describe the validation evidence and avoid laundering a bespoke method through familiar terminology.

Comparison results should be analysed with context; a two-decibel laboratory difference can be material in one band and unsurprising in another; random-effects models, robust statistics, and graphical comparisons can help, but the physical causes should also be examined. The aim is not merely to compute a proficiency score; it is to identify which parts of the measurement chain require tighter control.

Worked example 35.27. Between-team variance

Three teams measure the same room state and report 51.2, 52.0, and 49.8 dB for a defined metric; the mean is 51.0 dB and the sample standard deviation is 1.11 dB; the spread is larger than the project expected from within-team repeatability. Review finds different background-correction limits and door cycling; the campaign corrects procedure before using the data for acceptance.

35.28 Long-duration monitoring, trend analysis, control limits, and alarm design

A one-day acceptance test cannot represent every later operating state. Long-duration monitoring can reveal seal drift, masking outages, firmware changes, plant cycles, seasonal pressure, unusual access, or gradual structural change. Monitoring should be used selectively because it can collect sensitive audio, occupancy patterns, and operational metadata. The system should measure only what is authorised, minimise content collection, protect records, and define retention and response.[635][636][637]

Trend indicators should be physically meaningful and reproducible. Examples include a door-jamb level difference under a controlled local source, seal-contact force, closing time, masking band level, controller checksum, duct tone level, vibration transfer magnitude, or a brief automated room response. The indicator should be linked to the accepted baseline, method, position, source, instrument, uncertainty, and action limit. An arbitrary broadband number can drift for reasons unrelated to boundary integrity.

Control limits should reflect natural and measurement variation; a Shewhart chart can identify large shifts; cumulative-sum or exponentially weighted methods can identify smaller persistent drift; alarm thresholds should avoid excessive false positives that users learn to ignore, while preserving sensitivity to consequential change. The decision process should distinguish an instrument fault, missing data, environmental excursion, operational event, and technical degradation.

Monitoring data require time integrity and cybersecurity; clock changes, network outages, firmware updates, sensor replacement, calibration, and changed storage can create apparent trends; each maintenance event should be recorded; automated alarms should identify the relevant room, channel, state, threshold, duration, and supporting data. An alarm is a trigger for review, not proof of compromise or cause.

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635 MB-1079. National Protective Security Authority, 12 FAM 310.
636 MB-1078. National Protective Security Authority, Secure Working Areas. Identifier: Secure Working Areas. Status at the 16 August 2026 source freeze: Current public guidance at source freeze. Public locator: Technical role in this crosswalk: Primary.
637 MB-0427. Cybersecurity and Infrastructure Security Agency, NIST SP 800-37.

A simple z-score screen is

$$z = \frac{x - \mu_0}{\sigma_0},$$

where x is the current indicator, mu0 is baseline mean, and sigma0 is baseline standard deviation under comparable states. Normality and independence should not be assumed automatically. The score is descriptive unless the control model is validated.

Worked example 35.28. Persistent drift below a single-test threshold

A door indicator has baseline mean 31.0 dB and standard deviation 0.5 dB; four monthly values are 31.4, 31.7, 32.0, and 32.3 dB; the final z-score is 2.6; no individual value reaches a three-sigma alarm, but the monotonic sequence and declining contact measurement justify maintenance review. Trend logic detects the pattern earlier than a single limit.

35.29 Safety, hearing conservation, access, security, privacy, and ethical constraints

Acoustic testing can expose people and systems to high sound levels, electrical hazards, moving plant, pressurised ducts, work at height, confined spaces, fire-system impairment, heavy doors, lasers, and sensitive information. The test plan should include risk assessment, permits, hearing protection, exclusion zones, source limits, communications, emergency stop, electrical inspection, lifting, access, and restoration. Technical urgency does not suspend life safety.[638][639][640]

638 MB-0347. ASTM International, ASTM E336-25a, ASTM E2638-24.
639 MB-0346. ASTM International, ASTM E336-25a, ASTM E2638-24.
640 MB-1289. U.S. Department of State, 12 FAM 310.

Source level and duration should be limited to what the measurement requires; high-output loudspeakers can overheat, distort, trip protection, excite loose objects, disturb occupants, or damage hearing; the plan should identify maximum permissible exposure, source duty cycle, occupied areas, warning, and monitoring. Testing outside normal hours can reduce disruption but can also create unusually quiet backgrounds and different listener access; those differences should be part of the test state.

Speech-security testing raises privacy and ethics questions; real privileged, medical, diplomatic, or classified content should not be used as a test signal; standardised or synthetic speech-like sources can preserve relevant spectra and modulation without exposing protected information. Human listening panels require consent, language, hearing, training, data minimisation, and authorised access; recordings should be controlled and should not be retained merely because storage is convenient.

Security controls should permit valid science. Device restrictions, escorts, disconnected networks, and controlled data transfer can affect instrument selection and workflow. The team should validate the offline method before site work and should not improvise unapproved wireless or cloud services. Conversely, security procedures should not be used to conceal missing data or prevent legitimate independent review. The method and evidence access should be designed jointly with the responsible authority.

Ethical reporting avoids sensational inference. Audible speech does not by itself prove hostile collection; a technical vulnerability does not prove exploitation; a favourable test does not prove absolute security; the report should state observation, method, state, uncertainty, supported inference, alternative explanations, and authority disposition without dramatising or minimising the condition.

Worked example 35.29. Source exposure control

A test source produces 96 dBA at a nearby work position. The planned exposure is fifteen minutes. The project instead establishes an exclusion zone, reduces source duty cycle, uses remote control, verifies no unauthorised occupants remain, and monitors level at the boundary. The measurement still achieves required dynamic range while reducing exposure and operational risk.

35.30 Expert reports, independent peer review, testimony, and bounded opinion language

The final report should be organised around the decision. It should identify instructions, authority, qualifications, scope, exclusions, sources, configuration, methods, instruments, calibration, deviations, observations, calculations, uncertainty, results, opinions, limitations, recommendations, and data appendices. Facts supplied by others should be distinguished from direct observations. Calculations should be distinguished from professional opinions. Authority decisions should not be presented as measurements.[641][642][643][644]

Report language should preserve proposition boundaries. “The tested specimen achieved the reported laboratory transmission loss” differs from “the installed room satisfies the field requirement”; “speech was not intelligible under the tested listener and source state” differs from “speech

641 MB-0350. ASTM International, ASTM E336-25a, ASTM E2638-24.
642 MB-0346. ASTM International, ASTM E336-25a, ASTM E2638-24.
643 MB-0351. ASTM International, ASTM E336-25a, ASTM E2638-24.
644 MB-0809. International Electrotechnical Commission, IEC 60268-16:2020, ASTM E2638-24.

cannot be recovered”; “no evidence of the hypothesised path was observed within the examination” differs from “no path exists”. “The numerical decision rule passed” differs from “the facility is authorised”; precision protects both the reader and the technical record.

Independent peer review should examine requirement selection, source status, method scope, instrument chain, calibration, spatial and temporal sampling, raw data, corrections, excluded observations, uncertainty, software, figures, tables, and conclusion strength. Review should be completed before the report becomes an immutable release. Comments and responses should remain in a controlled review record even when the final report is clean. A reviewer should not sign outside the reviewer’s competence.

Expert testimony or dispute work adds procedural duties. The practitioner should preserve evidence, disclose assumptions and material limitations, avoid advocacy that outruns the data, and identify reliance on other disciplines. Demonstrative figures should be accurate and should not hide unfavourable bands through scale or averaging. Reanalysis after new information should be issued as a supplement or revised report rather than silently replacing the original.

Raw-data disclosure can be constrained by security, privacy, privilege, licensing, or proprietary formats. The report should state those limits and provide authorised review routes. A redacted or summary dataset should not be represented as complete if excluded information could affect the conclusion. Where disclosure is impossible, the opinion should be narrowed accordingly.

Worked example 35.30. Opinion narrowed by missing configuration evidence

A field test shows an adverse 250 Hz result, but the ceiling plenum above the room was inaccessible and no concealed-work record exists. The expert can report the measured result and identify plausible paths. The expert cannot attribute the loss confidently to the wall, ceiling, duct, or structure without further evidence. The opinion states the unresolved alternatives and proposes discriminating tests.

35.31 Seasonal, deferred, post-change, and recommissioning measurements

Commissioning should include the credible states available at handover and a controlled plan for states that cannot yet be reproduced. Exterior temperature, wind, rain, plant load, hydronic operation, stack pressure, occupancy, snow, and seasonal moisture can affect transfer and background. A summer test cannot automatically represent winter pressure or full heating operation. The authority should decide whether provisional use is acceptable and which deferred evidence is required.[645][646][647][648][649]

Deferred tests should have an owner, method, target state, test window, operating restriction, funding, access, witness, decision rule, and expiry. The baseline should identify which results are final and which are provisional. A deferred item that lacks an automatic escalation date is likely to disappear

645 MB-0808. International Electrotechnical Commission, IEC 60268-16:2020.
646 MB-0349. ASTM International, ASTM E336-25a, ASTM E2638-24.
647 MB-0449. FCDO Services, IEC 60268-16:2020, ASTM E2638-24.
648 MB-0448. FCDO Services, Secure Speech Environments. Identifier: Secure Speech Environments. Status at the 16 August 2026 source freeze: Current official public description. Public locator: Technical role in this crosswalk: Primary governmental servi.
649 MB-1290. U.S. Department of State, 12 FAM 310, UFC 4-010-05.

after turnover. The same control applies to equipment or software that is temporarily absent at initial testing.

Post-change testing should be proportionate to the mechanism; a like-for-like seal replacement may require functional inspection and a local indicator; a new cable penetration may require inspection, register update, and targeted acoustic check; a changed silencer, door, glazing system, structural support, masking controller, conferencing processor, or room use may require broader recommissioning. The change review should identify affected propositions rather than relying on an administrative category such as minor work.

Before-and-after comparison requires comparable source, positions, room absorption, background, environmental state, equipment, processing, and uncertainty. When exact reproduction is impossible, the difference should be modelled and the limitation stated. A local improvement can reveal a new dominant path. The programme should therefore repeat the controlling whole-room test after material correction.

Recommissioning closes with a new configuration baseline and authority disposition. Superseded evidence remains traceable. The report should identify changes, new results, unresolved limits, maintenance, monitoring, and future triggers. A room is not restored merely because its appearance matches the pre-change state.

Worked example 35.31. Before-and-after difference with correlated uncertainty

Before repair, a band result is 44.0 dB; after repair it is 47.0 dB; each result has standard uncertainty 1.0 dB, and shared calibration creates correlation $r = 0.6$; the standard uncertainty of the difference is

$$u_{\Delta}=\sqrt{1.0^2+1.0^2-2(0.6)(1.0)(1.0)}=0.89\,dB.$$

The estimated improvement is 3.0 dB with correlated standard uncertainty 0.89 dB, before model and configuration differences are added.

Table 35-2. Extended measurement and commissioning controls

Measurement subject	Principal failure mode	Required evidence	Disposition boundary
Multichannel timing	Unknown latency, drift or filter phase	Clock, trigger, delay test, common reference and time uncertainty	Phase and causal claims limited to validated range
Transfer functions	Unmeasured inputs, nonlinearity or poor coherence	Input-output spectra, estimator, coherence, state contrasts and model checks	Relation is state-specific and not sole-cause proof
Nonstationary events	Long averaging hides short exposure	Time history, event rule, pre-trigger record and source alignment	Event consequence reported separately from Leq
Low-frequency work	Sensor noise, drift, wind or building motion	Noise floor, environmental references, duration and mounting	Lowest valid frequency stated explicitly
Air-leakage proxies	Airflow is mistaken for sound insulation	Pressure state, method scope and separate acoustic confirmation	Proxy supports localisation, not acoustic conformity
Auxiliary NDT	Image or anomaly is treated as direct proof	Method conditions, location, competence and corroboration	Inference bounded until physical or acoustic verification
Software processing	Hidden defaults, stale criteria or rounding	Versioned code, parameters, test vectors and independent checks	Final decision uses validated unrounded calculation
Long monitoring	False alarms, clock error or privacy overcollection	Baseline, control limits, maintenance and data minimisation	Alarm triggers review, not automatic attribution

35.32 Instrument electrical integrity, overload, aliasing, grounding, shielding, and electromagnetic compatibility

A measurement chain can be acoustically well conceived and electrically wrong. Microphone polarisation, preamplifier supply, accelerometer constant-current excitation, input impedance, cable capacitance, connector condition, grounding, shielding, common-mode rejection, radio-frequency susceptibility, power quality, and digitiser headroom can alter the result before software receives a sample. The test plan should therefore record the complete electrical chain and should include functional checks that are capable of revealing intermittent connectors, wrong transducer power, saturated inputs, ground loops, and channel crosstalk.[650][651][652][653]

Overload can be visible or hidden. A clipped waveform is obvious when raw time data are retained, but an analogue preamplifier or conditioning stage can overload before the analyser indicates full scale. Impulsive door, hammer, valve, or alarm events can exceed peak capacity even when the long-term RMS level appears modest. The team should verify crest factor, peak range, overload indicators, preamplifier limits, transducer maximum level, and any automatic range changes. A lower-sensitivity transducer or parallel high-range channel can preserve impulsive events without sacrificing ordinary-state resolution.

Aliasing occurs when energy above the Nyquist frequency enters the sampled band; anti-alias filters should be active and appropriate to the sample rate; resampling, decimation, and exported data can introduce additional filters or aliasing if performed incorrectly. A nominal 48 kHz file does not prove that the original analogue chain was protected; the record should identify the analogue bandwidth, filter, sample rate, resampling algorithm, and the frequency range actually used for conclusions.

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650 MB-0456. FCDO Services, 12 FAM 310.
651 MB-0455. FCDO Services, UK NACE, Public technical-security note on laser eavesdropping. Identifier: Listening with Lasers. Status at the 16 August 2026 source freeze: Current public awareness article at source freeze. Public locator: Technical role.
652 MB-1212. UFC 4-010-05.
653 MB-1213. UFC 4-010-05, ISO 16283-1:2014.

Grounding and shielding should be arranged to reduce noise without defeating electrical safety or creating uncontrolled building connections; long sensor cables can form antennas, conduct structure-borne vibration, or bridge an isolation joint; fibre or isolated links can reduce electrical coupling but may add latency. Battery operation can remove mains loops while introducing state changes and finite operating time; cable routes, strain relief, connector torque where applicable, and separation from power or radio sources should be documented when they affect the evidence.

Electromagnetic compatibility matters particularly near radio transmitters, switching power supplies, variable-frequency drives, digital displays, access-control readers, and network equipment; rectification or interference can produce tones or modulation that resemble acoustic phenomena; a channel-capped input, dummy load, alternate cable route, equipment-off state, and radio-frequency survey can help distinguish electrical pickup from physical sound or vibration. The conclusion should remain within the authorised scope; detecting interference in an acoustic chain does not itself establish a compromising-emissions condition.

Worked example 35.32. Crest factor and hidden overload risk

A channel records 0.20 V RMS during a door slam and the digitiser full-scale peak is 1.0 V. If the event crest factor is 8, the estimated peak is 1.6 V, which exceeds the digitiser range despite the apparently modest RMS value. A parallel lower-gain channel or higher-range input is required. The calculation assumes the RMS estimate represents the same event window and does not identify earlier analogue-stage limits.

35.33 Spatial population inference, stratified sampling, hotspots, and mixed-effects structure

A field method commonly averages several source and receiver positions, yet a protected-room decision may also depend on local accessible positions. Spatial sampling should therefore distinguish the method population from the threat or use population. A grid selected to produce a room-average metric may not include a service cupboard, door jamb, ceiling void, raised-floor opening, facade edge, or other location where a listener can lawfully or unlawfully obtain better access within the authorised model. The report should preserve both standardised averages and justified hotspot investigations without blending them into one number.[654][655][656][657]

Sampling should be stratified by physical mechanism; wall field, corners, junctions, doors, glazing, services, plenum, floor, and structural interfaces can form distinct strata; random or systematic positions within the room support population inference, while targeted positions support diagnosis. The plan should label which is which; selecting only favourable points biases the result. Selecting only suspected weak points can misrepresent the room average. Both errors are avoided when the sampling purpose and selection rule are fixed before results are examined.

Spatial observations are correlated. Adjacent microphone positions share room modes, source directivity, background, and path geometry; treating every point as independent can understate uncertainty; a mixed-effects model can separate room or source effects from receiver-position and residual effects, provided the design has enough replication. In smaller

654 MB-1211. UFC 4-010-05.
655 MB-1274. U.S. Department of State, 12 FAM 350, UFC 4-010-05.
656 MB-1055. NIST SP 800-37, 12 FAM 010.
657 MB-1054. NIST SP 800-37.

projects, graphical position maps, repeated paths, and sensitivity analysis may be more transparent than a complex model; statistical sophistication should not conceal limited coverage.

Hotspot searches need stopping rules. A dense scan can locate a local maximum but can also increase the chance of finding an extreme caused by random background or a transient. The plan should define frequency range, step size, source stability, dwell, confirmation, and the method for converting a scan indication into a formal measurement. A handheld sweep can guide placement; it should not become the sole reported result unless its calibration, sampling, and uncertainty support that role.

For a simple random-effects representation,

$$y_{ij} = \mu + a_i + b_j + \epsilon_{ij},$$

where y_ij is an observation for source position i and receiver position j, mu is the overall mean, a_i is a source-position effect, b_j is a receiver-position effect, and epsilon_ij is residual variation. The model assumes additive effects and should be checked for interactions and frequency dependence.

Worked example 35.33. Effective independent position count

Twelve receiver observations have average pairwise correlation approximately 0.35. A screening effective sample size is

$$N_{eff} = \frac{N}{1+(N-1)\rho} = \frac{12}{1+11(0.35)} = 2.47.$$

The twelve readings do not provide the precision of twelve independent positions. The formula is a rough equal-correlation screen, not a substitute for the actual spatial model.

35.34 Measurement-model validation, sensitivity analysis, Monte Carlo propagation, and decision robustness

An uncertainty budget is credible only when the measurement model represents the decision quantity. Validation should examine dimensional consistency, limiting cases, independent calculations, residuals, calibration, repeatability, sensitivity, and comparison with physical observations. A model can be numerically precise and conceptually incomplete because it omits a flanking path, assumes a diffuse field that does not exist, treats a censored band as exact, or converts a diagnostic quantity into a contractual metric without authority.[658][659][660][661][662]

Sensitivity coefficients show how the result changes with each input; they can be obtained analytically, numerically, or through designed perturbation; sensitivity should be evaluated over plausible ranges, not only at one nominal point when the model is nonlinear. Inputs with small uncertainty can dominate if their sensitivity is large; inputs with large nominal uncertainty can matter little if the result is insensitive. The analysis should identify which additional measurement, inspection, or source verification would reduce decision uncertainty most effectively.

Monte Carlo propagation is useful when inputs are non-normal, correlated, bounded, censored, or combined through nonlinear equations; the simulation should state distributions, correlations, sample size, random seed or reproducibility method, convergence, and output statistic; a

658 MB-1056. NIST SP 800-37, UFC 4-010-06.
659 MB-0464. FCDO Services, UK National Authority for Counter-Eavesdropping, The UK National Authority for Counter-Eavesdropping. Identifier: UK NACE. Status at the 16 August 2026 source freeze: Current official public description. Public locator: Techn.
660 MB-0463. FCDO Services, UK National Authority for Counter-Eavesdropping, The UK National Authority for Counter-Eavesdropping. Identifier: UK NACE. Status at the 16 August 2026 source freeze: Current official public description. Public locator: Techn.
661 MB-1294. U.S. Department of State, 12 FAM 010.
662 MB-1276. U.S. Department of State, 12 FAM 350, 12 FAM 360.

triangular distribution chosen because it is convenient is still an assumption. Correlations should reflect shared calibration, geometry, processing, or environmental states; ignoring positive correlation can understate uncertainty; imposing unjustified correlation can overstate it.

Decision robustness should be tested against reasonable alternatives; the project can compare several background treatments, position sets, decay ranges, source stability rules, or model forms; a conclusion that changes under a minor defensible choice is fragile and should be reported accordingly. A conclusion that remains stable across plausible choices is stronger; sensitivity and robustness do not legitimise post hoc selection of the most favourable method. The primary rule should be fixed before testing, with alternatives used for diagnosis and limitation.

Where a result is limited by dynamic range, the model should preserve censoring. Reporting 70 dB when the receiving channel established only greater than 62 dB is false precision. Simulation can treat the value as an interval if the downstream decision requires it, but the report should retain the measurement limit. A single-number classification should not hide limited bands that control the source spectrum or authority decision.

Worked example 35.34. Nonlinear propagation through an energetic sum

Two receiving contributions are L1 = 30.0 dB and L2 = 29.0 dB, each with standard uncertainty 1.0 dB and independent normal screens; the combined level is 32.54 dB; because the logarithmic sum is nonlinear, the standard uncertainty is not obtained by adding decibel uncertainties. A Monte Carlo calculation or linear sensitivity in energy units is appropriate; the example identifies the model requirement; the final uncertainty depends on distributions and correlation.

35.35 Data fusion, contradictory observations, causal evidence, and bounded attribution

Complex investigations rarely produce one perfectly decisive observation. A pressure scan may indicate a door perimeter, intensity may indicate the leaf, vibration may indicate the frame, and temporary sealing may improve only selected bands. Data fusion should preserve these differences rather than forcing them into an arbitrary score. Each evidence item should be linked to the proposition it supports, its state, sensitivity, specificity, independence, uncertainty, and plausible alternative explanations.[663][664][665][666]

Evidence families can corroborate a mechanism when they depend on different physical principles. A local acoustic hot spot, visible seal discontinuity, contact-map gap, pressure-flow indication, and improvement under authorised temporary sealing collectively support a leakage mechanism more strongly than repeated pressure scans alone. Independence is not absolute. Several observations may share the same source drift, location error, or investigator expectation. The report should identify shared dependencies.

Contradictory observations are informative. High pressure with low active intensity can indicate a reactive field or room mode. Strong vibration with weak receiving pressure can indicate poor radiation efficiency or a sensor-location issue. A favourable room-average result with an adverse local

663 MB-1271. U.S. Department of State, 12 FAM 350.
664 MB-0388. Cabinet Office, 12 FAM 350.
665 MB-0917. International Organization for Standardization, ISO 19650-5:2020.
666 MB-0915. International Organization for Standardization, ISO 19650-5:2020.

speech position can indicate spatial access rather than method failure. The correct response is to revise the model, verify data quality, and design a discriminating intervention, not to discard the inconvenient observation.

Causal attribution should use temporal order, physical plausibility, dose or state relation, specificity, intervention response, and alternative-hypothesis testing. Temporal sequence alone is insufficient. A cable installation preceding a complaint may be causal, coincidental, or a marker for other work. A repair that improves the result supports the changed mechanism only when collateral changes are controlled. Removal and restoration, where safe and authorised, can provide stronger evidence.

The final opinion should state confidence qualitatively or quantitatively only when the scale is defined. Terms such as possible, probable, and certain can carry legal or institutional meanings that vary. The report should describe the evidence and unresolved alternatives directly. A bounded statement such as “the observed upper-band change is most consistent with the documented frame-perimeter gap under the tested pressure state” is stronger than an unexplained probability word.

Worked example 35.35. Evidence convergence and remaining alternative

A door-jamb scan is 8 dB above nearby wall positions; contact media show incomplete compression at the same segment; temporary sealing reduces the local receiving level by 6 dB, and the formal door result improves after adjustment. The evidence supports perimeter leakage as a material path; the room-pair result improves by only 2 dB because a duct path remains. Attribution is bounded to the door contribution and does not claim that every room weakness was corrected.

Table 35-3. Evidence-family reconciliation

Evidence family	Strongest supported proposition	Common alternative explanation	Required corroboration
Pressure or level scan	Spatial response under the measured field	Room mode, background or source directivity	Repeat state, reference channel and another method
Active intensity	Directional net energy flow over a surface	Reactive field, probe limitation or scan error	Field indicators, calibration and pressure comparison
Vibration and coherence	Structural response related to a reference	Common external input, mounting or timing error	State change, phase, mobility and spatial pattern
Visual or borescope observation	Directly visible local condition	Limited field of view or uncertain scale	Stable location, context and affected-population review
Temporary intervention	Response change after a controlled modification	Collateral changes, source drift or incomplete restoration	Reversal, reference channel and final formal retest
Speech or listener assessment	Bounded detectability or intelligibility	Language, listener, context and background dependence	Defined protocol, objective metrics and authority scope

35.36 Source-field characterisation, directivity, modal coverage, and excitation uniformity

A test source is not merely a level generator. Its directivity, power capability, distortion, spectral balance, temporal stability, position, orientation, boundary clearance, and interaction with the room determine which paths and modes are excited. A nominal omnidirectional loudspeaker becomes directional at higher frequencies, while a corner position can overexcite selected modes. A single position can leave modal nulls or shadowed surfaces. The test plan should therefore define the source field required by the method and should verify it with reference measurements rather than assuming that equal electrical drive produces equal acoustic excitation.[667][668][669][670]

667 MB-1269. U.S. Department of State, 12 FAM 360.
668 MB-1275. U.S. Department of State, 12 FAM 350, UFC 4-010-05.
669 MB-1271. U.S. Department of State, 12 FAM 350.
670 MB-0348. ASTM International, ASTM E336-25a, ASTM E2638-24.

Source calibration should distinguish electrical input, near-source pressure, room-average level, and radiated sound power. These quantities answer different questions. A reference microphone can monitor drift but can be affected by local interference or source motion. Multiple reference points or a rotating source can improve confidence. Source equalisation should not exceed loudspeaker linear range or create excessive crest factor. Equalisation filters, limiters, protection, and gain structure should be documented because they can change between pretest and formal test.

Modal coverage matters below the frequency at which the room approaches a diffuse field; moving the source, using several uncorrelated sources, or averaging positions can reduce dependence on one modal pattern; the method may prescribe positions and averaging, and those rules should be followed. Supplemental low-frequency investigation can use denser spatial sampling, but it should remain labelled as diagnostic unless it satisfies the contractual method; a strong result at one source location and weak result at another may reflect modal coupling, directivity, or a path near one location rather than inconsistent construction.

Source distortion can contaminate high-isolation tests. Harmonics generated in the source may fall in bands where the receiving room is more sensitive or the partition transmits differently. The team should measure source-room spectra, distortion where material, and receiving-room dynamic range. A broadband source should be checked for crest factor and amplifier clipping. A swept-sine method can improve signal-to-noise ratio and separate nonlinear components, but it may not match a standard method or a nonstationary operating source.

Excitation uniformity can be screened by the standard deviation of source-room levels across positions and bands. The statistic should not be interpreted without room geometry and method requirements. A low standard deviation can still coexist with strong local directivity, while a high standard deviation may be expected at low frequency. The report should retain individual position data and not only the average.

Worked example 35.36. Source drift and energetic bias

A four-position series uses source-room levels 90.0, 90.2, 89.9, and 88.5 dB because the amplifier protection reduces output during the final position. The energetic average is 89.7 dB, but the final path is evaluated with a source 1.5 dB below the first. A reference channel reveals the drift. The affected position should be repeated after the source is stabilised rather than corrected by a blanket average.

35.37 Door, glazing, and opening-specific field protocols under realistic operation

Operable elements require measurement in the state in which they will be used. A door result depends on leaf, frame, seals, threshold, hardware, latching, closer, hinges, automatic bottom, floor finish, pressure, cycling, and immediate surround. Glazing depends on pane build-up, dimensions, edge support, frame, mullions, gaskets, setting blocks, anchors, cavities, and perimeter seals. Access panels, hatches, transfer grilles, mail slots, cable doors, and removable barriers each have their own operational state. A wall-average result can hide these local paths.[671][672][673][674]

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671 MB-0981. JCGM 100:2008, JCGM 106:2012.
672 MB-0980. JCGM 100:2008.
673 MB-1277. U.S. Department of State, 12 FAM 390.
674 MB-1286. U.S. Department of State, Office of Inspector General, Review of the Department of State Physical Security Waivers and Exceptions Process. Identifier: ISP-I-24-19. Status at the 16 August 2026 source freeze: Official

Before acoustic testing, the team should inspect identity and operation; doors should be cycled from normal use, not forced into compression manually; contact should be mapped at head, jambs, meeting stiles, and threshold; latch engagement, closer speed, sweep, drop seal, hinges, floor tolerance, and pressure should be recorded. Glazing should be checked for pane identity, cavity, frame contact, gasket continuity, exposed sealant, mullion cavities, and condensate paths. The test should not damage finishes or alter the accepted hardware without authority.

Local source or receiver scans can identify a weak perimeter, but formal results require the applicable method and geometry; pressure-only scans are sensitive to room modes and source directivity; intensity can distinguish net radiation but has field limitations. Temporary sealing can test a hypothesis, yet the modified state must be recorded and restored; a successful temporary seal indicates that the treated region contributed under that state. It does not prove the permanent repair or complete-room compliance.

Pressure state should be varied where credible; positive room pressure can increase compression at one door orientation and reduce it at another; stack effect and smoke-control modes can reverse the differential; automatic operators and access-control releases can introduce transient open states or incomplete latching. The commissioning matrix should include normal, quiet, emergency, and failure states that materially affect the opening.

The field report should distinguish element result from room result. A door method can reduce some flanking influence, yet it does not establish every

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public oversight report.

path in the room. A glazing scan can identify a frame weakness, yet it does not replace the room-pair test. The acceptance dossier should link the opening result, immediate-surround evidence, room test, operation, maintenance, and authority decision.

Worked example 35.37. Pressure-dependent door contribution

A door-jamb receiving contribution is 30 dB at +5 Pa room pressure and 35 dB at -5 Pa because the latch-side gasket unloads; wall and ceiling contributions are 27 and 26 dB; the total receiving level changes from 32.4 dB to 35.8 dB. Testing only the positive-pressure state would miss a credible adverse condition; seal adjustment and pressure control should be evaluated together.

35.38 Duct, silencer, plenum, pipe, conduit, and service-path measurement under operating flow

Service paths should be measured as systems. A silencer laboratory insertion-loss report does not include installed transitions, casing breakout, access doors, dampers, branch geometry, supports, regenerated noise, leakage, or flanking. A duct test performed with fans off does not represent flow-generated noise, pressure, damper position, or plant vibration. Pipes, conduits, and cable pathways can carry pressure, structural force, and direct openings. The plan should define the source, termination, operating mode, flow, pressure, temperature, water state, support condition, and connected spaces.[675][676][677][678]

Duct cross-talk measurement should identify source terminal, receiving terminal, branch state, damper positions, airflow, fan speed, and background. A loudspeaker source can characterise passive path attenuation, while operational plant tests characterise actual source conditions. The two results should not be confused. Muting or temporarily blocking a branch can support diagnosis, but life safety, ventilation, smoke control, and equipment limits must be respected.

Silencer evaluation should include insertion loss, pressure loss, regenerated noise, casing radiation, and breakout. Measurements upstream and downstream require suitable locations and correction for flow, standing waves, and cross-sectional modes. Near-field pressure at a grille can differ materially from accessible listener level. The report should identify whether it measures duct-borne transfer, room response, or both.

Pipes should be tested in representative water and operating states; an empty, depressurised, or stationary pipe can be acoustically different from flowing water, pump operation, valve action, thermal movement, or sprinkler test; accelerometers and pressure sensors can identify coherent structural or fluid excitation. Support changes and flexible connectors can be tested under controlled conditions; the team should not alter life-safety systems without the responsible specialists.

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675 MB-1285. U.S. Department of State, Office of Inspector General, Review of the Department of State Physical Security Waivers and Exceptions Process. Identifier: ISP-I-24-19. Status at the 16 August 2026 source freeze: Official public oversight report.
676 MB-1279. U.S. Department of State, 12 FAM 390.
677 MB-1112. 32 CFR Part 117.
678 MB-1110. Office of the Director of National Intelligence, Standards for the Accreditation and Reciprocal Use of Sensitive Compartmented Information Facilities. Identifier: ICS 705-02. Status at the 16 August 2026 source freeze: Public standard liste.

Conduits and cable pathways deserve both physical and acoustic inspection; a spare conduit may be an open air path; a filled conduit can remain a rigid bridge; cable bundles can prevent complete closure. Path testing should be linked to the penetration register and should identify abandoned or future capacity. A favourable test before later cabling is not a lifetime result.

Worked example 35.38. Silencer benefit limited by casing breakout

A duct-borne contribution is predicted at 42 dB before a silencer. The silencer reduces internal path energy by 18 dB to 24 dB, but casing breakout contributes 31 dB and a support path contributes 28 dB. The combined result is

$$L = 10\log_{10}\left(10^{2.4} + 10^{3.1} + 10^{2.8}\right) = 33.3\,dB.$$

The whole-system improvement is about 9 dB, not 18 dB. Casing and support controls are required.

35.39 Deficiency classification, corrective action, retest scope, and release governance

Commissioning findings should be classified by mechanism and affected proposition. Categories can include incomplete construction, wrong product, damaged component, configuration error, operational state, calibration or data defect, method deviation, adverse result, missing evidence, authority condition, and safety or security restriction. A single label such as “failed test” conceals whether the room is physically deficient, the method is invalid, the state is wrong, or the evidence is incomplete.[679][680][681][682]

Each finding should carry a stable identifier, requirement, location, observed state, evidence, immediate control, responsible party, causal hypothesis, corrective action, inspection, retest, residual limitation, and closure authority. The record should preserve rejected hypotheses and superseded data. Cosmetic closure is not technical closure. Replacing a ceiling tile does not prove that a displaced barrier or service seal was restored.

Corrective action should address cause. A worn door seal can be replaced, but repeated early wear may require frame, closer, pressure, cleaning, or product review. A duct result can be improved with lining, but a short branch or casing path may remain. A software reset can restore masking, but the update and credential process may still be defective. Root-cause analysis should be proportionate and should avoid speculative blame when evidence is limited.

Retest scope should follow the changed path and the risk of path displacement; a local seal adjustment can be checked locally first, followed by the controlling door or room test; a reconstructed wall head, replaced silencer, new door, or changed control system may require broader testing. The plan should distinguish screening, diagnostic confirmation, formal

679 MB-1283. U.S. Department of State, Facility Operations. Identifier: 15 FAM 620. Status at the 16 August 2026 source freeze: Current public text at source freeze. Public locator: Technical role in this crosswalk: Primary governmental authority. Limit.
680 MB-1282. U.S. Department of State, Facility Operations. Identifier: 15 FAM 620. Status at the 16 August 2026 source freeze: Current public text at source freeze. Public locator: Technical role in this crosswalk: Primary governmental authority. Limit.
681 MB-1281. U.S. Department of State, Facility Operations. Identifier: 15 FAM 620. Status at the 16 August 2026 source freeze: Current public text at source freeze. Public locator: Technical role in this crosswalk: Primary governmental authority. Limit.
682 MB-1209. Treasury Board of Canada Secretariat, 32 CFR Part 117.

retest, and authority review; the same method, source, positions, state, calibration, and processing should be used where comparison is intended.

Release governance should prevent schedule pressure from converting open defects into silent assumptions. Conditional use requires explicit authority, restrictions, monitoring, expiry, and closure evidence. Final release requires reconciled configuration, closed or accepted findings, complete raw data, reports, uncertainty, training, maintenance, change triggers, and manifests. The laboratory or commissioning team reports evidence. The competent authority decides use.

Worked example 35.39. Retest matrix after three linked repairs

A room receives door adjustment, duct-support isolation, and a masking-controller update. Local checks confirm each repair. Formal retest repeats the door method, room-pair bands, structural reference channels, masking spectrum, and speech assessment under normal and quiet states. The project does not repeat unrelated facade testing, but it does verify that the three repairs did not create new operating or configuration conflicts.

Table 35-4. Deficiency and retest governance

Finding class	Immediate response	Minimum correction evidence	Formal release requirement
Method or calibration defect	Suspend affected conclusion	Corrected method, valid calibration and data review	Repeat or reprocess under pre-agreed rule
Missing concealed-work evidence	Preserve state and assess access	Direct observation, justified alternative evidence or stated limitation	Authority accepts evidence or requires opening
Physical path defect	Control use where necessary	Repair record, inspection and local confirmation	Controlling field test repeated
Software or operating-state defect	Freeze approved configuration	Export, checksum, functional test and access review	Integrated operating-state test and new baseline

Finding class	Immediate response	Minimum correction evidence	Formal release requirement
Adverse numerical result	Verify state, range and processing	Causal diagnosis and corrective action	Pre-agreed decision rule satisfied or authority conditions use
Authority condition	Apply restriction and expiry	Named owner, monitoring and closure evidence	Signed removal, renewal or replacement of condition

35.40 Calibration intervals, intermediate checks, repair history, and measurement-chain control

A calibration certificate is a dated statement about defined quantities and conditions. It does not guarantee that the instrument remained unchanged before or after calibration, that the correct settings were used, or that every accessory is covered. The measurement programme should establish calibration intervals, intermediate checks, transport controls, storage, warm-up, battery condition, environmental limits, repair history, firmware, and out-of-tolerance response. Intervals should be informed by manufacturer guidance, laboratory policy, stability history, use intensity, consequence, and applicable accreditation requirements rather than by an unexamined annual custom.[683][684][685][686]

Intermediate checks should challenge the material functions of the chain; a sound calibrator can check sensitivity at one frequency and level, but it does not verify microphone frequency response, preamplifier noise, analyser filters, channel timing, overload, or source stability. An accelerometer reference can check one axis and frequency while leaving mounting and

683 MB-1266. U.S. Department of State, Bureau of Overseas Buildings Operations, Overseas Buildings Operations Project Portfolio. Identifier: OBO public project portfolio. Status at the 16 August 2026 source freeze: Current public website at source freez.
684 MB-1264. U.S. Department of State, Bureau of Overseas Buildings Operations, Overseas Buildings Operations Project Portfolio. Identifier: OBO public project portfolio. Status at the 16 August 2026 source freeze: Current public website at source freez.
685 MB-1265. U.S. Department of State, Bureau of Overseas Buildings Operations, Overseas Buildings Operations Project Portfolio. Identifier: OBO public project portfolio. Status at the 16 August 2026 source freeze: Current public website at source freez.
686 MB-1022. Ministry of Housing, UFC 4-010-05.

cable effects unresolved; electrical injection can test analyser channels without testing the transducer; a useful check programme combines complementary tests and records acceptance limits before field work.

Out-of-tolerance findings require impact analysis. The team should identify the last known valid check, affected instruments, channels, projects, dates, quantities, and decisions. A small calibration shift may have no effect on a large margin and may materially affect a guarded result near the limit. The analysis should use the observed direction and magnitude where known, preserve uncertainty, and avoid assuming that drift was linear through time. Affected reports may require confirmation, supplement, withdrawal, or retest.

Repair or firmware change can alter the instrument baseline even when the serial number is unchanged; the chain record should identify components, microphones, preamplifiers, probes, cables, conditioners, adapters, calibrators, and software as separate controlled items; paired components should remain paired where calibration depends on the combination. Connector cleaning, cable replacement, or probe-spacer change can improve reliability while changing phase or sensitivity; the next field use should include an appropriate post-service verification.

Transport is part of control. Shock, moisture, temperature, pressure, contamination, and connector strain can affect sensitive equipment. Cases, desiccant, transit indicators, acclimatisation, and pre-use inspection may be justified. Equipment entering a controlled facility can also require security inspection and approved data handling. The plan should allow time for both technical stabilisation and authorised access.

Worked example 35.40. Out-of-tolerance impact screen

A microphone returns from calibration 0.7 dB low relative to its prior sensitivity; three recent guarded results exceeded their limits by 6.2, 2.0, and 0.4 dB; the first two remain numerically favourable under a conservative 0.7 dB correction, while the third no longer passes. The project reviews the third test state and repeats the affected measurement; the analysis does not assume that every channel or frequency drifted by the same amount.

35.41 Multi-room campaigns, population acceptance, sampling risk, and programme-level comparability

Organisations with many rooms often need a campaign rather than isolated tests. The programme should distinguish commissioning of every room, acceptance sampling of repeated construction, periodic portfolio assurance, and forensic testing after a common-cause finding. These purposes require different sample designs and decision rules. A sample that is adequate for production surveillance may be inadequate for authorising a high-consequence individual room. Population inference cannot replace a required room-specific authority decision.[687][688][689][690]

Sampling should reflect clusters. Rooms built by the same crew, from the same detail set, during the same period, with the same product lot or software version are not independent. Stratification by building, contractor, assembly, date, use consequence, and change history can produce more informative coverage than a simple random percentage. High-risk

687 MB-1021. Ministry of Housing, Communities and Local Government, Fire Safety in Buildings Other Than Dwellings. Identifier: Approved Document B.
688 MB-0440. 32 CFR Part 117, 12 FAM 350.
689 MB-0381. Cabinet Office, ISO 19650-5:2020, 12 FAM 010.
690 MB-0380. Cabinet Office, Government Security Classifications Policy. Identifier: Government Security Classifications Policy. Status at the 16 August 2026 source freeze: Current public classification policy at source freeze. Public locator: Technical.

interfaces, first-of-type units, unusual rooms, and previously defective populations may require complete testing. The plan should identify how an adverse sample expands the affected population.

Comparability requires a campaign protocol. Instruments, source systems, positions, operating states, processing, criteria, and report fields should be standardised. Where buildings differ, the protocol should preserve project-specific geometry and authority while retaining common indicators. A central reference artefact or periodic cross-check can reveal team or equipment drift. Data dictionaries, stable identifiers, units, and software versions are essential when results will be aggregated.

Population acceptance should address producer and consumer risk; a low sampling fraction can miss clustered defects; a strict rule can reject a stable population because of one method error; sequential or adaptive sampling can increase effort when evidence is ambiguous. The statistical plan should be fixed before results and should state defect definitions, criticality, lot boundaries, acceptance numbers, reinspection, and authority. Acoustic metrics should not be reduced to a binary defect without preserving band data and configuration.

Programme reports should present distributions, outliers, mechanisms, confidence limits, and missing data. Ranking rooms by one single-number rating can hide different weak paths and source states. A room with a favourable average and one adverse accessible position may deserve more attention than a lower average caused by an irrelevant band. Portfolio analytics should lead to details, training, maintenance, or change controls, not merely a league table.

Worked example 35.41. Clustered defect expands a campaign

A programme tests ten of forty nominally identical rooms. Two adverse rooms share the same doorset installation crew and week. Rather than treating the rate as two failures in ten independent rooms, the programme identifies fourteen rooms in the same cluster and tests all fourteen. Five additional door-contact defects are found. The response targets the causal population while preserving individual room decisions.

35.42 Pre-release replication, calculation review, and metrological decision conference

Before a consequential chapter or project report is sealed, the team should conduct a pre-release replication focused on the decisions that could change if one assumption, transcription, or processing step is wrong. The replication should select representative raw files, rebuild at least one result from the native data, verify calibration application, inspect source and receiver positions, recompute corrections, test equation units, confirm uncertainty and guard-band logic, and compare the report tables with the computational record. The reviewer should not rely solely on screenshots produced by the same software and operator.[691][692][693][694]

A metrological decision conference should bring together the test lead, independent technical reviewer, design representative, configuration custodian, and accepting authority or authorised delegate. The purpose is not to negotiate the measured value. It is to confirm that the requirement, measurand, method, state, uncertainty, decision rule, limitations, and

691 MB-0918. International Organization for Standardization, ISO 19650-5:2020, NIST SP 800-37.
692 MB-1279. U.S. Department of State, 12 FAM 390.
693 MB-1293. U.S. Department of State, 12 FAM 010, ICD 705.
694 MB-1280. U.S. Department of State, 12 FAM 390.

authority action refer to the same proposition. Open items should be visible. A technically favourable result should not be released while the represented room state remains disputed.

Replication should include adverse and boundary cases. A background-limited band, limited dynamic-range result, low-coherence structural component, conditional door state, or deferred HVAC mode deserves more scrutiny than a comfortable mid-band pass. The review should examine whether exclusions were pre-agreed, whether rounding altered a decision, whether source drift affected one position, whether timestamps align, and whether later construction or software changes occurred after testing.

The release record should identify the replicated calculations, reviewer, date, files, software, findings, corrections, and final disposition. Any change after replication should trigger targeted re-review and new hashes. Replication does not guarantee perfection, but it converts the report from a single-operator product into a traceable technical record whose most consequential steps have been challenged independently.

Worked example 35.42. Independent recalculation reveals a unit mismatch

The report converts acceleration to velocity using millimetres per second, while one script supplied metres per second without conversion; the displayed value is therefore wrong by a factor of one thousand; independent dimensional review detects the mismatch before release. The corrected value changes a structural-path ranking and the associated narrative; the report, calculation file, statistics, and checksum package are regenerated rather than patched silently.

35.43 Commissioning sequence, integrated systems and final authority record

Commissioning is the controlled progression from verified construction to tested operation and lifecycle baseline. It begins with owner requirements and the basis of design, not with the final acoustic test. The sequence should verify configuration, functional operation, calibration, preliminary dynamic range, formal measurements, diagnostics, correction, retest, training, handover and competent-authority disposition. [695][696][697][698]

Integrated systems can invalidate an otherwise valid room test; door hardware, access control, pressure, dampers, masking, audiovisual gain, emergency overrides, fire alarm, software, furniture, ceiling access and maintenance modes should be exercised; the test state should represent the final as-operated configuration or should carry a clear limitation. Deficiencies should be tracked by mechanism and affected proposition; the physical inquiry into commissioning sequence, integrated systems and final authority record separates what carries energy from what merely appears defective, thereby preserving alternative hypotheses until discriminating evidence is obtained.

The commissioning plan should define readiness gates, witnesses, instruments, methods, acceptance rules, deficiency workflow, retest scope, seasonal or deferred tests, training, spares, baseline indicators and change triggers. Repairs should be inspected before concealment and should not be accepted solely by improved sound data if adjacent fire, structural or service duties remain unresolved. The design team should provide maintainable

695 MB-1273. U.S. Department of State, 12 FAM 350, UFC 4-010-05.
696 MB-0979. JCGM 100:2008, JCGM 106:2012.
697 MB-1111. 12 FAM 010.
698 MB-1209. Treasury Board of Canada Secretariat, 32 CFR Part 117.

routes, inspection access and authorised replacement criteria so that later work on commissioning sequence, integrated systems and final authority record does not silently alter the boundary.

The final dossier should reconcile as-designed, as-submitted, as-installed, as-tested, as-authorised and as-operated states. It should include open conditions, residual risks, raw data, reports, drawings, registers, software baselines, checksums, maintenance and recommissioning schedule. Commissioning supports the authority decision. It does not self-authorise the facility. Inspection and measurement of commissioning sequence, integrated systems and final authority record should be scheduled while the controlling condition is still observable, with missed hold points treated as missing evidence rather than acceptance.

Worked example 35.43. Weighted commissioning-evidence screen

Five evidence classes have weights 0.25, 0.20, 0.20, 0.20 and 0.15. Their completion states are 1.0, 1.0, 0.9, 0.8 and 0.6. Calculate the weighted completeness screen.

$$E_c = 0.25(1.0) + 0.20(1.0) + 0.20(0.9) + 0.20(0.8) + 0.15(0.6)$$

E_c is a dimensionless project-management screen. Weights sum to one.

E_c equals 0.88. The incomplete classes should be identified and closed or carried as limitations.

The screen does not prove conformity, authenticity or authority acceptance.

Chapter 35 establishes measurement as an integrated engineering and evidentiary process. The correct sequence begins with the authorised question and measurand, preserves the exact construction and operating state, selects a method within its scope, controls source and receiver sampling, and uses instrumentation whose calibration and dynamic range support the required bands.

Laboratory reports, field room-pair quantities, doorset tests, plenum and duct methods, vibration, intensity, speech privacy and masking each answer bounded questions. Background, reverberation, spatial dependence, covariance and model limitations must remain visible. Diagnostic interventions can identify mechanisms, but cannot be concealed inside formal acceptance results.

The commissioning dossier therefore reconciles as-designed, as-submitted, as-installed, as-tested, as-authorised and as-operated evidence. Chapter 36 receives that reproducible baseline and uses it to investigate later complaints, failures, incidents and change without confusing susceptibility, causation and authority.

Table 35-5. Release gate

Gate	Controlling question	Minimum record	Failure response
Requirement	What outcome or bounded condition is required?	Source, owner, state and decision authority	Clarify or suspend the affected work
Configuration	What exact physical and operating state is represented?	Drawings, submittals, asset and route identifiers	Reconcile discrepancies before acceptance
Inspection	What conditions were directly observable before concealment?	Hold-point record, measurements and images	Open, reconstruct or carry a stated limitation
Measurement	What quantity was measured, where, when and with what uncertainty?	Raw data, calibration, method, state and processing	Correct the method or repeat the test
Authority	Who may accept, condition, restrict or reject the result?	Signed disposition and limitations	Do not represent technical review as authorisation
Lifecycle	What later change can invalidate the result?	Baseline, maintenance and retest triggers	Reopen review and update the controlled record

Chapter 35 Glossary

Aliasing. Folding of frequency content above the Nyquist frequency into the sampled band when anti-alias protection or resampling is inadequate.

Background correction. Energetic removal of measured background contribution from a source-on receiving level within a valid method and dynamic range.

Calibration. Operation establishing a documented relation between indication and reference quantity with stated uncertainty and traceability.

Coherence. Frequency-dependent statistic describing the consistency of a linear relation between measured input and output under the estimator assumptions.

Configuration uncertainty. Incomplete knowledge of the physical or operating state represented by a measurement.

Decision rule. Pre-established method for comparing a result and its uncertainty with a requirement.

Dynamic range. Usable level interval within which the source, measurement chain and background support the required inference.

Energetic average. Average performed in linear energy units before reconversion to decibels.

Event trigger. Hardware or software condition used to mark and preserve an intermittent event, preferably with pre-trigger and post-trigger context.

Field check. On-site verification intended to reveal gross change or error before or after measurement, distinct from laboratory calibration.

Frequency-response function. Estimated relation between an input and output as a function of frequency under a stated system and noise model.

Guard band. Intentional separation between an acceptance limit and the decision threshold used to control decision risk.

Measurand. Quantity intended to be measured under a stated measurement model.

Model discrepancy. Difference between the selected mathematical or conceptual representation and the real system.

Normalised door insertion loss. Field quantity used by ASTM E2964 to evaluate a suitable installed doorset under the method conditions.

Pressure-residual-intensity index. Instrument or probe capability relevant to distinguishing active intensity from large pressure fields.

Proficiency comparison. Controlled comparison of laboratories, teams, instruments, or processing intended to evaluate reproducibility and identify method differences.

Reference channel. Channel monitoring source or system state to support stability and causal interpretation.

Reverberation time. Time associated with a specified decay of room sound energy under the applicable method.

Spatial average. Combination of measurements from defined positions to represent the method quantity over a region or room.

Speech privacy. Degree to which speech is not audible or intelligible to an unintended listener under stated conditions.

Time-base synchronisation. Control and verification of relative sampling time, trigger, latency, and clock drift among measurement channels.

Traceability. Property of a result whereby it can be related to references through a documented unbroken calibration chain with stated uncertainties.

Uncertainty budget. Structured account of input quantities, distributions, sensitivities, covariance and combined measurement uncertainty.

Chapter 36. Forensic Failure Analysis, Leakage Localisation, Remediation, Change Control, and Recommissioning

A secure room can fail without spectacle. A familiar name may become audible only after the air-handling plant enters a night mode; a cadence may be felt through a slab; a door seal may whistle under one pressure condition; or a commissioning result may no longer agree with the accepted baseline. None of those observations identifies a cause. Each marks the beginning of a bounded forensic inquiry in which the room, its services, its electronic systems, its operating rules, and its records must be preserved long enough to explain what changed.

Figure 36-1. Forensic acoustic investigation moves from an authorised question through preservation, baseline reconstruction, discriminating tests, remedy, retest, and controlled closure. Author's original diagram.

36.1 Forensic failure analysis as a bounded engineering inquiry

The governing problem is causal discrimination under an authorised and preserved configuration, not the discovery of an acoustically interesting anomaly. The inquiry should predeclare the proposition, competing mechanisms, observable discriminators, evidentiary custody, and the decision that the investigation is intended to support. A location, spectral feature, or improved reading is not itself a cause; conclusions remain bounded by access, configuration, uncertainty, and the lawful scope of examination.

The opening record identifies the protected function, source state, receiving access, time window, required decision, available baseline, and restrictions on examination. Every evidence object used for forensic failure analysis as a bounded engineering inquiry should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.1 uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[699]

A polished spectrum can conceal an undefined question, an altered scene, or a metric that answers a different proposition. The test plan for forensic failure analysis as a bounded engineering inquiry should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.1 has weight only when the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

Freeze avoidable change, appoint technical and information-control authorities, and record explicit stop conditions before intrusive work begins. Closure states the strongest conclusion supported, the states not tested, the residual alternatives, and the authority that accepted the disposition. The final statement for forensic failure analysis as a bounded engineering inquiry should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision

699 MB-0570. ASTM International, ASTM E3176-24.

authority. Section 36.1 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[700]

Worked example 36.1. Defect-opportunity sample size

Engineering question. How many approximately independent opportunities should be examined to obtain at least 95% probability of observing one defect when prevalence is screened at 4%?

Variables and assumptions. p is screened defect prevalence; c is desired detection confidence; n is the required number of independent opportunities.

Result and engineering significance. The mathematical screen gives 74 opportunities. The plan must stratify them by installer, shift, detail, material lot, and location because clustering reduces independence.

Limitation. The equation does not prove prevalence and does not replace judgement about the affected population.

Worked example 36.2. Uncertainty of a bounded comparison

Engineering question. Does a 6.2 dB change exceed the combined standard uncertainty when the two measurements share part of the calibration chain?

Variables and assumptions. Delta is the observed difference; u1 and u2 are standard uncertainties; rho is the correlation coefficient; uDelta is uncertainty of the difference.

Result and engineering significance. The difference is large relative to the stated measurement uncertainty, supporting a real change under the compared states.

700 MB-0571. JCGM 100:2008.

Limitation. Configuration mismatch, model discrepancy, and unmeasured state changes are not contained in this calculation.

36.2 Complaint triage and immediate protective action

Immediate work should separate human recollection, system state, access history, source conditions, and reproducibility while imposing only those temporary controls needed to prevent further exposure or evidentiary loss. Complaint triage converts an initially ambiguous report into an information-preserving protective response. Premature repair, public speculation, or indiscriminate shutdown can destroy the causal record and create consequences disproportionate to the evidence.

Obtain neutral witness accounts, access and alarm records, system logs, a sketch of locations, and the earliest reproducible source and background state. Every evidence object used for complaint triage and immediate protective action should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.2 uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[701]

Leading interviews, public speculation, immediate repair, or a blanket shutdown can destroy causal evidence and needlessly expand the information footprint. The test plan for complaint triage and immediate protective action should name at least one alternative explanation and record the observation expected under each competing model. Negative

701 MB-0593. International Organization for Standardization, ISO 31000:2018.

evidence in Section 36.2 has weight only when the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

Apply proportionate temporary controls, such as use restrictions, alternate rooms, controlled schedules, or increased access standoff, while preserving the original state. The triage record distinguishes protective action from causal finding and assigns a review time for each temporary control. The final statement for complaint triage and immediate protective action should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.2 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[702]

Table 36-1. Complaint symptom, candidate path, and immediate discriminating action

Observed symptom	Candidate mechanism	Discriminating observation or intervention	Important confounder
Upper-band speech concentrated at a jamb	Perimeter gap, failed compression seal, shallow backing, or frame cavity	Seal-contact map, local pressure or intensity scan, reversible membrane test	Receiving-room reflection, changed door pressure, or talker position
Low-frequency cadence through floor or wall	Slab, frame, pipe, duct, machinery, or rigid support path	Synchronous vibration, transfer-function comparison, source isolation, and structural tracing	Room mode, unrelated machinery, or electrical contamination
Privacy loss only after hours	Lower background, masking outage, reduced airflow, changed access, or intermittent operation	State-matched background survey, control-log comparison, and repeated listening or metric test	Different source level, listener familiarity, or changed furniture

702 MB-0592. ASTM International, ASTM E2638-24.

Observed symptom	Candidate mechanism	Discriminating observation or intervention	Important confounder
Failure after contractor visit	New penetration, disturbed seal, altered controller, or moved support	Change-history reconstruction, photographs, inventory, and first-principles path inspection	Previously latent defect discovered coincidentally
Local response near a grille	Duct cross-talk, breakout, terminal-device radiation, or plenum bypass	Branch isolation, grille removal under authority, intensity scan, and airflow-state comparison	Fan-noise change, pressure shift, or regenerated noise

Worked example 36.3. Energetic background subtraction

Engineering question. What source-only level is estimated when the source-on total is 46 dB and the comparable background is 38 dB?

Variables and assumptions. L_total is the source-on total level; l_background is the source-off level; l_source is the energetically corrected estimate.

Result and engineering significance. The corrected estimate is 45.3 dB, and both raw levels must remain in the record.

Limitation. The correction becomes unstable as the source-on margin narrows and does not identify the path.

Worked example 36.4. Temporary-control residual exposure

Engineering question. What residual exposure index remains when a temporary control is expected to reduce exposure by 72% but is reliable for only 90% of the authorised-use period?

Variables and assumptions. R0 is the uncontrolled exposure index; e is conditional effectiveness; r is reliability; r is residual exposure.

Result and engineering significance. The residual index is 0.063, not zero. Reliability and inspection frequency therefore matter as much as nominal attenuation.

Limitation. The index is a planning quantity, not a calibrated probability of compromise.

36.3 Preservation of the room, systems, and digital state

Properly framed, preservation extends beyond the visible room because acoustical behaviour is coupled to controls, software, plant operation, masking, telecommunications, and adjacent spaces. A defensible freeze records physical positions, door and damper states, set points, firmware, logs, raw files, time references, and recent interventions before troubleshooting changes them. The preserved state is necessarily selective, so the record must identify what could not be frozen and how that limitation affects later comparison.

Create a contemporaneous photographic survey, serialised equipment inventory, configuration export, cryptographic manifest, clock-offset record, access log, and controlled list of unavoidable changes. Every evidence object used for preservation of the room, systems, and digital state should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.3 uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[703]

703 MB-0615. National Institute of Standards and Technology, FIPS PUB 180-4, Secure Hash Standard.

A hash can prove that a copied file is unchanged while saying nothing about whether the original log was complete, correctly clocked, or generated by the claimed device. The test plan for preservation of the room, systems, and digital state should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.3 has weight only when the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

Use write-protected collection where practicable, preserve native files and metadata, and maintain an evidence register linking every derivative to its source. Release of the scene requires a signed baseline, a record of changes made during examination, and a defined restoration state. The final statement for preservation of the room, systems, and digital state should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.3 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[704]

Table 36-2. Preservation and authority controls for the examination

Evidence object	Preservation action	Authority or safety dependency	Release condition
Room and envelope	Photograph, map, seal, and restrict avoidable work	Owner, security authority, fire safety, facilities operations	Signed scene baseline and controlled restoration plan
Building systems	Export setpoints and logs; record valves, dampers, fan modes, masking, and alarms	Controls administrator, mechanical authority, operational safety	Verified return to authorised state with changes logged

704 MB-0614. ASTM International, ASTM E2713-25.

Evidence object	Preservation action	Authority or safety dependency	Release condition
Digital devices and files	Acquire native exports, hashes, clocks, firmware, and configuration identifiers	Information owner, cyber authority, privilege and privacy review	Manifest, custody record, and approved derivative set
Physical samples	Assign identifier, photograph in situ, package, seal, and document transfer	Destructive-opening authority, hazardous-material and evidence controls	Receipt, storage location, test disposition, and restoration record
Witness information	Use neutral questions and preserve contemporaneous notes	Counsel, human resources, privacy, and security governance	Approved factual summary with source and limitation

Figure 36-2. Preservation must bind physical, digital, measurement, witness, and authority records into one traceable state.

Worked example 36.5. Evidence-manifest completeness

Engineering question. What fraction of the collected digital items is represented in the signed hash manifest?

Variables and assumptions. N_h is the number of hashed items; n_t is the number collected; c_m is manifest completeness.

Result and engineering significance. The manifest is 97.76% complete. The six omitted items must be identified or the collection cannot be described as completely manifested.

Limitation. Matching hashes support bit-level integrity only; they do not establish completeness, correct clocking, or truth of the source data.

Worked example 36.6. Controller-clock drift

Engineering question. A controller clock offset grows from 2.4 s to 3.4 s during a 90 min test. What average drift rate should be applied when aligning events?

Variables and assumptions. Delta t is change in offset; t is elapsed test time; r_d is average drift rate.

Result and engineering significance. The average drift is 0.0111 s/min. Event alignment should use a time-dependent correction rather than one fixed offset.

Limitation. Linear drift is an assumption; clock steps, network time corrections, and logging latency require separate checks.

36.4 Authority, privilege, safety, and information handling

The analytical burden is exacting. Authority, privilege, safety, and information handling are constitutive boundary conditions of the investigation rather than administrative matters appended after testing. The examination plan should allocate who may authorise intrusive work, receive protected observations, waive operational constraints, and determine whether legal privilege or national-security handling limits disclosure. Technically available evidence may remain unusable when its acquisition exceeded authority, compromised safety, or exposed information outside the approved chain.

The investigation plan identifies who may authorise entry, imaging, log acquisition, sampling, destructive opening, witness contact, disclosure, and final release. Every evidence object used for authority, privilege, safety, and information handling should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.4 uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[705]

An acoustically attractive opening may be impermissible because it compromises a fire barrier, creates an electrical hazard, exceeds the engagement, or reveals protected information. The test plan for authority, privilege, safety, and information handling should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.4 has weight only when the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

Use permits, isolations, escorts, counsel instructions, information markings, redaction rules, sample-custody protocols, and stop-work authority appropriate to the site. The report describes the authority relied upon and the resulting limits without asserting legal conclusions outside the expert remit. The final statement for authority, privilege, safety, and information handling should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.4 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[706]

Worked example 36.7. Authority-and-record coverage

Engineering question. What bounded coverage score results when 39 of 46 required authority and evidence fields are verified and four more are conditionally supported?

705 MB-0637. United States Courts, Federal Rules of Evidence 702, 703, 705, and 901, Expert testimony, bases of opinion, disclosure, and authentication rules.
706 MB-0636. United States Courts, Federal Rules of Civil Procedure 26.

Variables and assumptions. N_v is verified fields; n_c is conditionally supported fields; n_r is required fields; c is the bounded coverage score.

Result and engineering significance. The planning score is 0.891. The remaining fields must still be listed because one missing authority can be more consequential than several complete administrative fields.

Limitation. The weighting is a transparent planning convention, not a legal sufficiency test.

Worked example 36.8. Pressure force during a controlled opening

Engineering question. What net force acts on a 2.05 square metre door leaf under a 35 Pa pressure difference before intrusive inspection?

Variables and assumptions. Delta p is pressure difference; a is leaf area; f is net pressure force.

Result and engineering significance. The pressure load is approximately 71.8 N, which can affect latch release and safe opening control.

Limitation. Closer force, friction, hinge geometry, and transient airflow are omitted; the calculation is a safety screen.

36.5 Baseline reconstruction from requirements and drawings

This inquiry should be treated as a coupled physical and evidentiary problem. Baseline reconstruction is an exercise in evidentiary archaeology across requirements, drawings, submittals, field records, commissioning data, and operational decisions. The investigator should distinguish the as-designed, as-approved, as-built, as-tested, and as-operated states and should treat conflicts among them as evidence requiring resolution rather than choosing the newest drawing by convenience. A reconstructed baseline supports comparison only to the extent that its provenance, omissions, and configuration uncertainty are explicit.

Create a revision genealogy, requirement-to-detail matrix, field-verification plan, discrepancy register, and confidence grade for each material configuration claim. Every evidence object used for baseline reconstruction from requirements and drawings should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.5 uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[707]

As-built labels can conceal unrecorded substitutions, site instructions, field-routed services, abandoned openings, and repairs made after acceptance. The test plan for baseline reconstruction from requirements and drawings should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.5 has weight only when the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

Resolve high-consequence conflicts through direct inspection, targeted measurement, manufacturer records, contractor interviews, and authorised opening where necessary. The reconstructed baseline separates verified fact, credible inference, unresolved discrepancy, and inaccessible condition.

707 MB-0658. International Organization for Standardization, ISO 10005:2018.

The final statement for baseline reconstruction from requirements and drawings should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.5 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[708]

Worked example 36.9. Drawing-reconciliation matrix

Engineering question. How should the reconstruction register summarise 84 configuration fields when 69 agree, 10 conflict, and five are missing?

Variables and assumptions. N_a is agreeing fields; n_c is conflicting fields; n_m is missing fields; n_t is total fields.

Result and engineering significance. Approximately 82.1% of fields agree, while 17.9% require resolution or explicit uncertainty grading.

Limitation. A field count does not measure consequence; one unresolved wall-head detail may outweigh many agreed finish notes.

Worked example 36.10. Revision-set usability

Engineering question. What proportion of an 18-drawing package is usable after three superseded sheets and two unverified sheets are segregated?

Variables and assumptions. N_u is usable sheets; n_t is total sheets; p_u is usable proportion.

Result and engineering significance. Thirteen sheets, or 72.2%, are presently usable. The excluded sheets remain in the genealogy rather than being deleted.

708 MB-0659. United States Department of Defense, UFGS 01 45 00, Quality Control.

Limitation. Usability means suitable for the stated reconstruction task, not proof that each drawing matches field construction.

36.6 Commissioning records, raw data, and comparability

A defensible examination begins from a bounded proposition. Commissioning evidence acquires probative value only when raw observations, instrument metadata, spatial sampling, processing, and acceptance logic remain recoverable. Review should test whether the earlier measurand, source spectrum, receiving conditions, averaging method, background correction, and uncertainty are genuinely comparable with the present inquiry. A favourable historic summary cannot be treated as a baseline when the underlying state or calculation chain is unavailable.

Measurement quality in Section 36.6 depends on the complete chain from measurand to final data product. Within Section 36.6, transducer mounting, calibration history, dynamic range, spatial sampling, temporal averaging, firmware, and data reduction influence the result differently. A number obtained during commissioning records, raw data, and comparability can be highly repeatable yet unrepresentative of the accessible receiving population, or representative yet still insufficient for the institutional decision.

Recover native analyser files, calibration certificates, field checks, source recordings, photographs, test plans, calculations, software versions, issue logs, and signed dispositions. Every evidence object used for commissioning records, raw data, and comparability should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.6

uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[709]

A single-number rating can agree while the governing low-frequency or consonant-band performance has materially changed. The test plan for commissioning records, raw data, and comparability should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.6 has weight only when the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

Recalculate selected results from raw data, compare like-for-like bands and states, and document every unavoidable departure from the original method. The baseline is assigned a comparability grade rather than being treated as either perfectly valid or wholly useless. The final statement for commissioning records, raw data, and comparability should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.6 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[710]

Table 36-3. Baseline record hierarchy and comparability questions

Record layer	Examples	Forensic question	Common limitation
Requirement	Owner criteria, authority correspondence, room data sheet, basis of design	What performance and operating states were actually required?	Later summaries can omit caveats or controlled criteria

709 MB-0664. International Organization for Standardization, ISO 16283-1:2014.
710 MB-0663. ASHRAE and IES, ANSI/ASHRAE/IES Standard.

Record layer	Examples	Forensic question	Common limitation
Design	Drawings, specifications, calculations, schedules, approved substitutions	What system was intended and what assumptions supported it?	Issue status and coordination may be unclear
Construction	Submittals, RFIs, photographs, hold points, nonconformance records	What was installed, changed, concealed, or accepted?	Coverage can be selective and photographs can lack orientation
Commissioning	Plans, calibration, raw data, scripts, states, results, punch lists	What was measured, where, when, and under which configuration?	Processed reports may omit raw channels and failed trials
Operation	Maintenance, access, alarms, firmware, work orders, incidents	How did the accepted state change before the complaint?	Logs may use inconsistent clocks or retention periods

Worked example 36.11. Like-for-like commissioning comparison

Engineering question. What is the supported difference between an accepted baseline of 52.1 dB and a current result of 48.4 dB when uncertainty is correlated?

Variables and assumptions. Delta is current minus baseline; uDelta includes covariance from shared method and calibration.

Result and engineering significance. The current result is 3.7 dB lower with standard difference uncertainty 1.22 dB, warranting investigation under matched states.

Limitation. The calculation assumes the historical state and processing can be reconstructed adequately.

Worked example 36.12. Comparability grade

Engineering question. What weighted comparability score results from source, geometry, instrument, background, processing, and configuration grades?

Variables and assumptions. g_i are criterion grades from 0 to 1; w_i are weights summing to one; c is the comparability score.

Result and engineering significance. The bounded score is 0.865. The report should still list the weak configuration and background dimensions rather than hiding them in the average.

Limitation. Weights are project-defined and cannot substitute for a method requirement or expert judgement.

36.7 Change history, maintenance, and contractor work

The decisive distinction is between observation and causal proof. Change history is often the most efficient route to a plausible mechanism because apparently minor work can alter parallel paths, source states, or receiving backgrounds. Maintenance records, permits, access logs, purchase orders, software releases, photographs, and contractor interviews should be arranged chronologically and linked to the physical boundary and system configuration. Temporal association raises a hypothesis; it does not establish causation without a mechanism and a discriminating observation.

Build a time-ordered change register from work orders, permits, invoices, access records, photographs, material records, controller logs, and interviews. Every evidence object used for change history, maintenance, and contractor work should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.7 uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[711]

Chronology alone does not prove causation, and an undocumented change can be older than the first complaint. The test plan for change history, maintenance, and contractor work should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.7 has weight only when the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

Rank changes by affected source, path, receiver, listener access, control logic, and evidentiary consequence, then inspect the highest-value candidates first. Every causal finding identifies the change mechanism and the evidence that separates it from coincidental timing. The chronology should be reconciled with the penetration, door, equipment, and masking controls developed in Chapters 25 through 27. The final statement for change history, maintenance, and contractor work should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.7 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[712]

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711 MB-0665. International Organization for Standardization, ISO 9001:2015.
712 MB-0666. United States Department of Defense, UFGS 01 45 00, Quality Control.

Worked example 36.13. Uncontrolled-change rate

Engineering question. What observed monthly rate follows from 31 potentially consequential changes over 18 months?

Variables and assumptions. N is the number of screened changes; t is elapsed months; lambda is the observed rate.

Result and engineering significance. The observed rate is 1.72 changes per month. This informs workload and sampling but does not prove every change affected performance.

Limitation. Work-order completeness and detection bias must be considered.

Worked example 36.14. Chronology lag

Engineering question. A ceiling-access change occurred on project day 255 and the first recorded complaint was on day 312. What is the observed lag?

Variables and assumptions. t_c is complaint date; t_h is change date; delta t is chronology lag.

Result and engineering significance. The recorded lag is 57 days. That chronology is compatible with causation but does not establish it.

Limitation. The actual onset may precede the complaint, and other changes within the interval require review.

36.8 Search effort allocated by expected information

Engineering judgement must remain traceable. Search effort should be allocated according to expected information gain rather than the visual accessibility of a location or the investigator’s preferred instrument. A rational sequence ranks hypotheses by consequence, prior plausibility, test cost, reversibility, and the degree to which a result would change the next decision. This approach does not require numerical pretence; it requires an explicit reason why one observation is more discriminating than another.

Section 36.8 keeps observation, model, and judgement separate. For Section 36.8, the model simplifies the room, while the judgement explains how strongly the observed contrasts support one mechanism over its alternatives. For search effort allocated by expected information, configuration uncertainty, inaccessible construction, state mismatch, and model discrepancy may outweigh the narrow calibration uncertainty attached to the instrument display.

For each proposed action, record the hypotheses affected, predicted observations, cost, disruption, safety constraints, information sensitivity, and collateral variables. Every evidence object used for search effort allocated by expected information should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.8 uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[713]

Large data volume can create false confidence when measurements repeat the same geometry, state, or modelling assumption. The test plan for search effort allocated by expected information should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.8 has weight only when

713 MB-0668. National Institute of Standards and Technology, NIST/SEMATECH e-Handbook of Statistical Methods, Engineering statistics reference.

the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

Use staged testing, decision trees, pre-defined escalation criteria, and value-of-information reasoning to move from non-invasive screening to targeted intrusion. The search log records why an action was selected, what it changed, what it ruled out, and what remained unresolved. The final statement for search effort allocated by expected information should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.8 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[714]

Worked example 36.15. Expected value of a discriminating test

Engineering question. What planning value results when a proposed reversible test has a 28% chance of avoiding a 180,000 dollar unnecessary repair, costs 16,000 dollars, and causes 9,000 dollars of disruption?

Variables and assumptions. p is probability the test changes the decision; b is avoided cost; c_t is test cost; c_d is disruption; EVI is expected value of information.

Result and engineering significance. The planning value is positive at 25,400 dollars, supporting the test if safety and information controls are acceptable.

Limitation. The probability and avoided cost are decision assumptions, not measured physical quantities.

714 MB-0667. ASTM International, ASTM E2713-25.

Worked example 36.16. Search-priority index

Engineering question. How can a transparent priority screen compare expected information with cost, disruption, and examination risk?

Variables and assumptions. I is normalised information value; c, D, and R are normalised burdens; p is the planning priority index.

Result and engineering significance. The index is 1.06. It helps rank actions but does not override mandatory safety or authority constraints.

Limitation. Normalised scores are judgemental and should be sensitivity-tested.

36.9 Baseline acoustic measurements and comparability

Baseline measurement is meaningful only when the compared configurations are technically commensurate. Source positions, source stability, room absorption, receiving positions, background, HVAC state, door pressure, masking, and analysis settings should be controlled or their differences quantified. An apparent deterioration may reflect state mismatch, while a true defect may be concealed by favourable background or averaging.

Measurement quality in Section 36.9 depends on the complete chain from measurand to final data product. Within Section 36.9, transducer mounting, calibration history, dynamic range, spatial sampling, temporal averaging, firmware, and data reduction influence the result differently. A number obtained during baseline acoustic measurements and comparability can be highly repeatable yet unrepresentative of the accessible receiving population, or representative yet still insufficient for the institutional decision.

Measure source and receiving rooms, record geometry and states, verify dynamic range, preserve raw data, and obtain enough spatial coverage to represent accessible listener locations. Every evidence object used for baseline acoustic measurements and comparability should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.9 uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[715]

A precise result at one convenient microphone position can be repeatable but unrepresentative; background correction can also become unstable near the method limit. The test plan for baseline acoustic measurements and comparability should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.9 has weight only when the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

Use the governing field method where applicable, supplemented by diagnostic measurements clearly labelled as such. The baseline report distinguishes standardised results, diagnostic observations, and security conclusions requiring additional authority. The final statement for baseline acoustic measurements and comparability should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.9 should also

715 MB-0670. International Organization for Standardization, ISO 16283-1:2014.

identify the observation, change, or elapsed condition that would require the finding to be reopened.[716]

Worked example 36.17. Normalised field level difference

Engineering question. What normalised level difference follows from source and receiving levels of 86 dB and 39 dB with receiving-room reverberation time 1.15 s?

Variables and assumptions. L1 and L2 are spatial average levels; t is receiving reverberation time; t0 is reference time; DnT is the normalised difference.

Result and engineering significance. The illustrative normalised difference is 50.6 dB for the stated band and state.

Limitation. The calculation does not represent a single-number rating and requires compliance with the adopted field method.

Worked example 36.18. Source-stability check

Engineering question. What repeatability is observed across five source-level checks?

Variables and assumptions. L_i are repeated source levels; lbar is the mean; s is sample standard deviation.

Result and engineering significance. The source mean is 84.10 dB with standard deviation 0.29 dB, adequate for a stable comparison under the stated plan.

Limitation. Spatial source directivity and spectral stability still require separate checks.

716 MB-0669. International Organization for Standardization, ISO 12999-1:2020.

36.10 Symptom mapping and spatial localisation

Local audibility, band levels, vibration, intensity, airflow, and listener observations should be registered to coordinates, boundary features, and operating states so that clusters and gradients can be distinguished from sampling noise. Symptom mapping treats the room as a spatially and operationally varying transfer system rather than a single rating. A hot spot identifies where energy is observed, not necessarily where it entered the transmission network.

Measurement quality in Section 36.10 depends on the complete chain from measurand to final data product. Within Section 36.10, transducer mounting, calibration history, dynamic range, spatial sampling, temporal averaging, firmware, and data reduction influence the result differently. A number obtained during symptom mapping and spatial localisation can be highly repeatable yet unrepresentative of the accessible receiving population, or representative yet still insufficient for the institutional decision.

Use repeatable coordinates, multiple source positions, narrow bands or one-third-octave bands, close-range and stand-off observations, and state-matched background checks. Every evidence object used for symptom mapping and spatial localisation should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.10 uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[717]

717 MB-0572. ASTM International, ASTM E336-25a.

A coarse grid can miss a small defect; an excessively fine grid can multiply correlated data without improving causal resolution. The test plan for symptom mapping and spatial localisation should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.10 has weight only when the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

Begin with reconnaissance spacing, refine around stable gradients, and verify candidate regions with an independent method or controlled intervention. The localisation map carries frequency, source state, coordinate system, interpolation method, and an explicit statement that colour contours are not causal proof. The final statement for symptom mapping and spatial localisation should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.10 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[718]

Table 36-4. Localisation methods and their inferential limits

Method	Primary quantity or observation	Principal strength	Primary ambiguity
Spatial sound-pressure scan	Frequency-band pressure level	Fast mapping of local maxima and state changes	Room modes and reflections can imitate a boundary leak
Sound-intensity scan	Net acoustic energy flow per unit area	Ranks radiating surfaces and estimates partial sound power	Reactive field, phase mismatch, probe spacing, and background
Vibration response and coherence	Acceleration or velocity with source relation	Identifies structure-borne coupling and synchronous response	High coherence does not prove a unique causal route

718 MB-0573. National Institute of Standards and Technology, NIST/SEMATECH e-Handbook of Statistical Methods, Engineering statistics reference.

Method	Primary quantity or observation	Principal strength	Primary ambiguity
Airflow or pressure-assisted inspection	Flow, pressure, tracer movement, smoke, or thermal cue	Locates air leakage that may also transmit sound	Flow path and acoustic impedance are not equivalent
Controlled source or branch isolation	Difference between reproducible operating states	Provides strong discriminating contrast when collateral variables are recorded	Shutdown changes background, pressure, force, and occupancy
Borescope or controlled opening	Direct visual or physical observation	Confirms concealed geometry, void, support, or penetration condition	Intrusive work changes the scene and samples only a small region

Worked example 36.19. Reconnaissance-grid size

Engineering question. How many nominal grid points result on an 8.0 m by 3.2 m boundary using 0.4 m spacing in both directions?

Variables and assumptions. W and H are boundary dimensions; s is spacing; n_x and N_y are point counts; n is total points.

Result and engineering significance. The nominal grid contains 189 points before exclusions and adaptive refinement.

Limitation. Nearby points are correlated; the count is not an independent sample size.

Worked example 36.20. Hot-region repeatability

Engineering question. A candidate hot region appears in five of six state-matched scans. What simple repeatability proportion should be reported?

Variables and assumptions. N_h is scans containing the region; n_s is total comparable scans; p_h is repeatability.

Result and engineering significance. The region repeats in 83.3% of comparable scans and merits independent confirmation.

Limitation. The proportion is not a causal probability and does not account for spatial-registration error.

36.11 Frequency signatures and path-family screening

Properly framed, frequency signatures are screening evidence that can discriminate among path families when interpreted with geometry, modal behaviour, source content, and instrument limits. Broadband trends, narrow resonances, combing, coincidence regions, duct modes, and machinery orders should be compared against physically plausible transfer mechanisms rather than matched by visual resemblance alone. Spectral similarity is non-unique and should be corroborated through controlled perturbation or transfer measurement.

Measurement quality in Section 36.11 depends on the complete chain from measurand to final data product. Within Section 36.11, transducer mounting, calibration history, dynamic range, spatial sampling, temporal averaging, firmware, and data reduction influence the result differently. A number obtained during frequency signatures and path-family screening can be highly repeatable yet unrepresentative of the accessible receiving population, or representative yet still insufficient for the institutional decision.

Compare transfer functions, octave or narrow-band spectra, coherence, phase where valid, source spectra, vibration, and operating-state changes. Every evidence object used for frequency signatures and path-family screening should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.11 uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[719]

Post-processing choices, windowing, spectral leakage, analyser overload, non-stationarity, and asynchronous clocks can manufacture or obscure apparent signatures. The test plan for frequency signatures and path-family screening should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.11 has weight only when the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

Retain native time data where proportionate, state analysis parameters, and test whether the signature follows the suspected source or path under controlled change. A signature elevates or lowers hypotheses; it does not identify a component without spatial and configuration evidence. The final statement for frequency signatures and path-family screening should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.11 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[720]

Figure 36-3. A symptom should be expanded into competing path families before the team selects a localising method.

Worked example 36.21. Weighted spectral centroid

Engineering question. What centroid summarises a diagnostic response distributed across five octave bands?

719 MB-0574. International Electrotechnical Commission, IEC 61672-1:2013.
720 MB-0575. International Organization for Standardization, ISO 7626.

Variables and assumptions. f_i are band-centre frequencies; w_i are linear diagnostic weights; f_c is the weighted centroid.

Result and engineering significance. The centroid is approximately 743.8 Hz, useful for comparing states or locations.

Limitation. A centroid discards bandwidth and multimodal structure and cannot identify the path by itself.

Worked example 36.22. Coherence-screen uncertainty

Engineering question. What approximate standard error accompanies magnitude-squared coherence 0.78 estimated from 20 effectively independent averages?

Variables and assumptions. gamma2 is magnitude-squared coherence; k is effective independent averages; s_gamma is a screening standard error.

Result and engineering significance. The screening standard error is about 0.070; the observed coherence is useful but not exact.

Limitation. The approximation assumes stationarity and independent averages and does not exclude a common reference or electrical coupling.

36.12 Direct partition transmission and leaf behaviour

The analytical burden is exacting. Direct partition transmission must be assessed as the response of a finite, restrained, and often non-uniform assembly. Leaf mass, stiffness, damping, cavity coupling, stud or tie conditions, edge restraint, penetrations, and coincidence behaviour should be examined by band and related to the actual source and receiver geometry. A laboratory rating remains useful evidence, but it does not isolate the direct field from installed flanking or workmanship effects.

Compare field response with assembly evidence, inspect construction thickness and fasteners, measure vibration on both leaves, and test multiple source positions. Every evidence object used for direct partition transmission and leaf behaviour should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.12 uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[721]

Applying ideal mass law to a framed double-leaf wall can produce a persuasive but physically irrelevant prediction. The test plan for direct partition transmission and leaf behaviour should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.12 has weight only when the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

Use screening calculations to identify plausible bands, then rely on field observations and verified construction for attribution. A direct-leaf finding states the tested boundary region and does not silently extend to the complete room. The final statement for direct partition transmission and leaf behaviour should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.12 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[722]

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721 MB-0577. International Organization for Standardization, ISO 10140-2:2021.
722 MB-0576. Carl Hopkins, Sound Insulation, 2007, Sound Insulation.

Worked example 36.23. Ideal mass-law screen

Engineering question. What ideal normal-incidence mass-law screen applies to a 48 kg/m2 leaf at 500 Hz?

Variables and assumptions. m is surface mass in kg/m2; f is frequency in Hz; r is ideal screening transmission loss.

Result and engineering significance. The ideal screen is approximately 40.6 dB.

Limitation. Coincidence, stiffness, damping, studs, cavities, finite size, leakage, and flanking are omitted.

Worked example 36.24. Mass-air-mass resonance screen

Engineering question. What ideal cavity resonance is estimated for two 24 kg/m2 leaves separated by a 90 mm air cavity?

Variables and assumptions. rho is air density; c is sound speed; d is cavity depth; m1 and m2 are surface masses; f0 is ideal resonance.

Result and engineering significance. The ideal resonance is approximately 57.8 Hz and helps choose diagnostic bands.

Limitation. Stud coupling, absorption, finite panels, leakage, and room modes change the installed response.

36.13 Perimeter leakage, cracks, and concealed gaps

This inquiry should be treated as a coupled physical and evidentiary problem. Perimeter discontinuities require three-dimensional analysis because a visually small crack may couple into cavities, frames, plenums, or adjacent layers. Pressure scanning, local level differences, smoke or tracer methods where lawful, borescope examination, and reversible sealing can test the continuity and depth of a suspected opening. A surface blemish should not be declared causal until the intervention changes the relevant transfer under a controlled state.

Combine close-range pressure or intensity scans, light and borescope inspection, pressure-assisted air-leakage methods, temporary membranes, and dimensional records. Every evidence object used for perimeter leakage, cracks, and concealed gaps should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.13 uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[723]

A temporary cover can add mass, stiffness, damping, and restraint as well as close a gap, so the observed contrast is not automatically attributable to air sealing alone. The test plan for perimeter leakage, cracks, and concealed gaps should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.13 has weight only when the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

Record membrane material, area, attachment, pressure state, contact, and restoration, then seek a second discriminating observation. The final finding identifies the physical discontinuity, its continuity, and the evidence connecting it to the measured consequence. The final statement for

723 MB-0578. ASTM International, ASTM E1186-22.

perimeter leakage, cracks, and concealed gaps should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.13 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[724]

Worked example 36.25. Composite effect of a small open-equivalent gap

Engineering question. How does a 0.001 m2 open-equivalent discontinuity screen against a 20 m2 boundary idealised at 60 dB?

Variables and assumptions. S is wall area; r_wall is wall attenuation; a is gap area; tau is area-weighted transmission coefficient; r_c is composite attenuation.

Result and engineering significance. The composite screen is approximately 42.9 dB, demonstrating the leverage of a small parallel path.

Limitation. A real slot has impedance and frequency dependence; the calculation is a diagnostic bound.

Worked example 36.26. Seal-contact coverage

Engineering question. What contact coverage follows when 5.95 m of a 6.8 m doorset perimeter shows verified working compression?

Variables and assumptions. L_c is verified contact length; l_t is total seal length; c is contact coverage.

Result and engineering significance. Verified contact covers 87.5% of the perimeter, leaving 0.85 m for targeted diagnosis.

724 MB-0579. David A. Bies, Colin H. Hansen, and Carl Q. Howard, Engineering Noise Control, 6th ed., 2024, Engineering Noise Control: Theory and Practice.

Limitation. Contact media do not by themselves establish compression force, durability, or acoustic consequence.

36.14 Doorsets, frames, seals, and pressure sensitivity

A defensible examination begins from a bounded proposition. A doorset is a pressure-sensitive mechanical system whose leaf, frame, seals, threshold, hinges, latch, closer, and surrounding construction interact dynamically. Investigation should relate leakage and audibility to closure force, latch engagement, differential pressure, seal compression, wear, temperature, and operational cycling rather than testing one carefully adjusted position. Temporary taping may isolate a mechanism, but it cannot be reported as ordinary performance or accepted as a durable repair.

Map contact with reproducible media, measure operating force and gap geometry, test multiple cycles, compare pressure states, and inspect frame anchorage and perimeter closure. Every evidence object used for doorsets, frames, seals, and pressure sensitivity should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.14 uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[725]

Holding a door shut by hand, over-adjusting a latch, or disabling a closer can create a non-operational test state that cannot support acceptance. The test plan for doorsets, frames, seals, and pressure sensitivity should name at least one alternative explanation and record the observation expected

725 MB-0580. ASTM International, ASTM C919-24.

under each competing model. Negative evidence in Section 36.14 has weight only when the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

Use reversible adjustment only under authority, record every setting, and retest accessibility, fire, egress, and security functions after repair. Closure requires both acoustic evidence and confirmation that the doorset remains compliant with its other duties. The final statement for doorsets, frames, seals, and pressure sensitivity should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.14 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[726]

Worked example 36.27. Pressure-assisted doorset load

Engineering question. What pressure force acts on a 2.1 m2 door under a 28 Pa room pressure difference?

Variables and assumptions. Delta p is pressure difference; a is leaf area; f is force.

Result and engineering significance. The pressure contributes approximately 58.8 N to opening or closing force depending on direction.

Limitation. Closer torque, seals, hinges, velocity, and code-required operating force remain separate.

726 MB-0581. ASTM International, ASTM E814-24.

Worked example 36.28. Frame-twist effect on seal compression

Engineering question. A seal is designed for 4.0 mm working compression, but local frame twist removes 2.3 mm. What compression remains?

Variables and assumptions. c_d is design compression; delta is geometric loss; c_r is remaining compression.

Result and engineering significance. Only 1.7 mm remains at the affected corner, which may be below the seal working range.

Limitation. The calculation does not determine acoustic loss without the seal characteristic and actual contact condition.

36.15 Glazing, mullions, and frame cavities

The decisive distinction is between observation and causal proof. Glazing failures may arise in the pane, laminate, edge bite, frame, mullion, anchors, perimeter seal, cavity, or an optical and structural coupling that bypasses nominal airborne performance. Band-resolved pressure and vibration measurements, frame perturbation, line-of-sight review, and inspection of concealed drainage or pressure-equalisation routes should be coordinated. Replacing glass alone is unjustified when the dominant transfer belongs to the frame or adjoining construction.

Use panel and frame vibration, close-range scans, perimeter inspection, controlled damping or temporary closure, and comparison among nominally identical bays. Every evidence object used for glazing, mullions, and frame cavities should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.15 uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[727]

A resonance observed on glass can be driven by a frame or cavity, while a quiet pane can coexist with leakage at a concealed mullion splice. The test plan for glazing, mullions, and frame cavities should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.15 has weight only when the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

Treat each pane-frame-perimeter system as a network and preserve manufacturer and installation details. The conclusion states whether evidence supports pane transmission, frame transmission, leakage, or an unresolved combination. The final statement for glazing, mullions, and frame cavities should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.15 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[728]

Worked example 36.29. Glazing cavity-resonance screen

Engineering question. What ideal mass-air-mass resonance is estimated for 25 and 18 kg/m2 glazing leaves separated by 55 mm?

Variables and assumptions. m1 and m2 are pane surface masses; d is cavity depth; rho and c describe air; f0 is ideal resonance.

727 MB-0582. Carl Hopkins, Sound Insulation, 2007, Sound Insulation.
728 MB-0583. International Organization for Standardization, ISO 7626.

Result and engineering significance. The ideal resonance is approximately 79.2 Hz, directing attention to low-frequency frame and cavity behaviour.

Limitation. Frame compliance, cavity absorption, panel dimensions, and leakage are omitted.

36.16 Ceilings, plenums, raised floors, and interstitial routes

Engineering judgement must remain traceable. Interstitial spaces convert apparently local boundaries into distributed networks with remote source and receiver opportunities. Ceiling plenums, raised floors, access panels, partitions above ceilings, service corridors, and structural voids should be mapped for continuity, absorption, leakage, access, and changing operational states. A room-average result can conceal a highly local route into an accessible void and should be supplemented by path-specific observations.

Trace physical continuity, test source positions near suspected routes, compare ceiling tiles and access panels, inspect above and below floors, and use plenum-specific methods where applicable. Every evidence object used for ceilings, plenums, raised floors, and interstitial routes should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.16 uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[729]

729 MB-0585. International Organization for Standardization, ISO 10848-1:2017.

A room-pair average can hide a local path into an accessible service space, while a plenum test may retain unrelated structural or duct contributions. The test plan for ceilings, plenums, raised floors, and interstitial routes should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.16 has weight only when the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

Map every accessible zone connected to the interstitial volume and identify states created by removed panels or maintenance access. Closure includes reinstatement controls and a register of panels, barriers, and penetrations that require future inspection. The final statement for ceilings, plenums, raised floors, and interstitial routes should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.16 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[730]

Worked example 36.30. Parallel interstitial paths

Engineering question. What complete-path attenuation results from three independent routes screened at 52, 55, and 58 dB?

Variables and assumptions. R_i are path attenuations; tau_total is the sum of linear transmission coefficients; r_total is combined attenuation.

Result and engineering significance. The combined screen is approximately 49.6 dB, lower than the strongest individual route.

730 MB-0584. Carl Hopkins, Sound Insulation, 2007, Sound Insulation.

Limitation. The model assumes compatible references and incoherent energetic addition.

36.17 HVAC cross-talk, breakout, break-in, and regenerated noise

HVAC transmission is bidirectional and state-dependent, combining in-duct propagation, breakout, break-in, regenerated turbulence, casing vibration, and common-branch coupling. The inquiry should record fan speed, damper position, airflow, pressure, terminal condition, lining, silencer configuration, and branch topology while comparing representative operating modes. Airflow direction does not establish acoustic direction, and shutting down plant for a test may remove the very condition under investigation.

Use plant-state matrices, in-duct and room measurements, vibration, pressure and airflow records, branch isolation where safe, and source tracking across operating states. Every evidence object used for hvac cross-talk, breakout, break-in, and regenerated noise should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.17 uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[731]

Stopping a fan changes background, pressure, structural excitation, talker effort, and damper position, so a level change is not automatically a duct-path contrast. The test plan for hvac cross-talk, breakout, break-in, and

731 MB-0586. ASHRAE, 2023 ASHRAE Handbook - HVAC Applications, Sound and vibration control and related applications chapters.

regenerated noise should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.17 has weight only when the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

Design interventions to separate source transmission, regenerated noise, breakout, and background effects. The remedy is verified under the complete range of authorised airflow and emergency states, not only at a quiet commissioning condition. The duct and plant analysis must remain consistent with the HVAC mechanisms and state controls developed in Chapter 24 and the commissioning method in Chapter 35. The final statement for hvac cross-talk, breakout, break-in, and regenerated noise should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.17 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[732]

Worked example 36.31. Duct path with regenerated noise

Engineering question. A duct source is 82 dB, installed insertion loss is 31 dB, and regenerated noise at the receiver is 46 dB. What combined receiving level results?

Variables and assumptions. L_s is source level; IL is insertion loss; l_t is transmitted level; l_r is regenerated noise; l_total is energetic sum.

Result and engineering significance. The combined level is approximately 52.2 dB, so regenerated noise is not negligible.

732 MB-0587. ASTM International, ASTM E336-25a.

Limitation. The calculation does not distinguish speech-bearing transmission from non-information-bearing airflow noise.

36.18 Pipes, conduits, sprinklers, and cable pathways

Pipes, conduits, sprinkler lines, cable trays, and bundles should be traced beyond the immediate penetration and tested through reversible support or closure changes where safe and authorised. Services create coupled airborne and structure-borne routes through the medium, sleeve, supports, annulus, seals, and connected equipment. A neat surface firestop does not prove acoustic continuity, while acoustic treatment must not compromise fire, movement, electrical, or hydraulic duty.

Trace each service across the boundary, record supports and clearances, compare excitation states, inspect firestop and smoke-seal conditions, and use vibration or local acoustic measurements as appropriate. Every evidence object used for pipes, conduits, sprinklers, and cable pathways should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.18 uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[733]

A visually filled sleeve can remain acoustically weak because of rigid contact, hidden voids, porous material, or connected boxes. The test plan for pipes, conduits, sprinklers, and cable pathways should name at least one alternative explanation and record the observation expected under each

733 MB-0588. ASTM International, ASTM E2174-24.

competing model. Negative evidence in Section 36.18 has weight only when the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

Coordinate any repair with fire, smoke, electrical, hydraulic, structural, and maintainability requirements. The service register becomes part of the new baseline and triggers review whenever fill, support, or route changes. Chapter 25 provides the governing service-penetration, firestop, pipe, conduit, and cable-path context for this diagnosis. The final statement for pipes, conduits, sprinklers, and cable pathways should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.18 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[734]

Worked example 36.32. Service-support transmissibility

Engineering question. What ideal motion transmissibility applies at frequency ratio 5.2 with damping ratio 0.08?

Variables and assumptions. r is forcing-to-natural frequency ratio; zeta is damping ratio; t is ideal transmissibility.

Result and engineering significance. The ideal transmissibility is 0.050, suggesting isolation under the assumed single-degree-of-freedom model.

Limitation. Rigid bypasses, pipe stiffness, restraints, base flexibility, and multi-axis response can dominate the installed path.

734 MB-0589. International Organization for Standardization, ISO 20816-1:2016.

36.19 Electronic, audiovisual, and operational confounders

Properly framed, electronic and operational confounders can imitate, amplify, mask, or export an acoustical symptom without a defect in the architectural boundary. Teleconferencing gain, microphones, loudspeakers, telephones, sensors, building automation, alerts, networked devices, and human operating practices should be placed within the same time-synchronised state record as physical measurements. The acoustic investigator should not infer cyber or technical-surveillance causation from a signal pattern without the appropriate specialist evidence.

Inventory devices and interfaces, preserve configuration and logs, test authorised operating modes, isolate local and network functions, and compare acoustic and electronic paths. Every evidence object used for electronic, audiovisual, and operational confounders should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.19 uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[735]

A mute indicator may represent a software state rather than a physical disconnection; a recording may include processing that changes level, spectrum, timing, and apparent direction. The test plan for electronic, audiovisual, and operational confounders should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.19 has weight only when

735 MB-0590. International Electrotechnical Commission, IEC 60268-16:2020.

the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

Coordinate acoustic, cyber, TSCM, and system-owner examinations without treating one discipline as a substitute for another. The report identifies whether the evidence concerns building transmission, electroacoustic reproduction, network transport, or an unresolved mixture. Chapter 26 supplies the device-state, firmware, conferencing, sensor, and building-automation baseline that the forensic inquiry must preserve. The final statement for electronic, audiovisual, and operational confounders should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.19 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[736]

Worked example 36.33. Event-log alignment

Engineering question. A conferencing controller log is 1.8 s ahead of reference time while a building controller is 2.6 s ahead. What relative offset must be applied when comparing events?

Variables and assumptions. o_a and o_b are offsets from the same reference; delta o is relative offset.

Result and engineering significance. The building-controller event appears 0.8 s later relative to the conferencing log after reference correction.

Limitation. Transport latency, batching, and clock drift require separate treatment.

736 MB-0591. Office of the Director of National Intelligence, Technical Specifications for Construction and Management of Sensitive Compartmented Information Facilities, Version 1.5.1, Public SCIF technical specifications.

36.20 Sound masking, background, and quiet-state dependence

The analytical burden is exacting. Masking and background are controlled environmental variables, not permanent credits that may be assumed from one daytime observation. Measurements should capture ordinary, quiet, degraded, failed, and maintenance states, including spectral balance, spatial uniformity, availability, controls, and alarm or emergency overrides. A room that depends on an undocumented favourable background has not demonstrated a stable physical isolation condition.

Measure frequency-resolved background at accessible positions across credible states, preserve masking settings and logs, and compare source-to-background margins. Every evidence object used for sound masking, background, and quiet-state dependence should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.20 uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[737]

A daytime test can overstate protection if the governing exposure occurs after hours; an A-weighted average can conceal quiet consonant bands. The test plan for sound masking, background, and quiet-state dependence should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.20 has weight only when the method possessed enough access, bandwidth,

737 MB-0595. International Electrotechnical Commission, IEC 60268-16:2020.

dynamic range, spatial coverage, and state control to reveal the predicted effect.

Treat masking as an active controlled dependency with monitoring, fault response, configuration management, and failure-state testing. Closure states the minimum background or masking state relied upon and the operational controls needed to maintain it. Chapter 27 explains why background and masking state can change speech consequence without changing the enclosure itself. The final statement for sound masking, background, and quiet-state dependence should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.20 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[738]

Figure 36-4. State-dependent investigation requires explicit control of source, boundary, plant, background, and listener-access variables.

Worked example 36.34. Band speech-to-background margin

Engineering question. How does a 3 dB masking increase change speech-to-background margins in the 500, 1000, and 2000 Hz bands?

Variables and assumptions. L_s is residual speech; l_b is background; m is band margin.

Result and engineering significance. The margins change from [2, 3, 4] dB to [-1, 0, 1] dB, likely reducing audibility in the tested positions.

Limitation. The calculation does not prove zero intelligibility or acceptable masking uniformity.

738 MB-0594. ASHRAE Standard 230-2022.

36.21 Structural vibration, mobility, and re-radiation

This inquiry should be treated as a coupled physical and evidentiary problem. Structure-borne transmission requires a force, mobility, propagation, and radiation model rather than an airborne analogy. Simultaneous vibration and acoustic observations, transfer mobility, operating deflection, phase or coherence where appropriate, and controlled source interruption can distinguish excitation from receiving-surface radiation. A high acceleration reading at one point does not by itself quantify information recovery or identify the originating connection.

Use properly mounted accelerometers, synchronous source references, transfer functions, mobility tests where justified, operational deflection comparisons, and surface-radiation measurements. Every evidence object used for structural vibration, mobility, and re-radiation should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.21 uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[739]

High coherence can occur through a common electrical or processing reference; low coherence can result from non-stationarity, multiple sources, or inadequate signal-to-noise ratio. The test plan for structural vibration, mobility, and re-radiation should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.21 has weight only when the method

739 MB-0597. International Organization for Standardization, ISO 20816-1:2016.

possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

Confirm sensor mounting and phase behaviour, then use controlled source or support changes to distinguish candidate routes. The finding identifies the measured transfer path and avoids converting a vibration level directly into an information-security conclusion. The final statement for structural vibration, mobility, and re-radiation should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.21 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[740]

Worked example 36.35. Vibration velocity level

Engineering question. What vibration velocity level corresponds to RMS velocity 2.8 micrometres per second relative to 1 nanometre per second?

Variables and assumptions. v is RMS velocity; v0 is reference velocity; l_v is velocity level.

Result and engineering significance. The velocity level is 68.9 dB re 1 nm/s.

Limitation. A velocity level does not directly predict radiated sound without mobility, mode shape, area, and radiation efficiency.

36.22 Sound intensity and energy-flow localisation

A defensible examination begins from a bounded proposition. Sound-intensity methods can localise net energy flow when pressure-only mapping is ambiguous, but their assumptions and near-field limitations must remain

740 MB-0596. Frank Fahy and Paolo Gardonio, Sound and Structural Vibration, 2nd ed., 2007, Sound and Structural Vibration.

visible. Probe spacing, phase calibration, background, reactive field, surface discretisation, averaging, and the distinction between signed and absolute intensity should be documented. Intensity may identify a radiating region while remaining insufficient to determine the concealed construction defect that produced it.

Measurement quality in Section 36.22 depends on the complete chain from measurand to final data product. Within Section 36.22, transducer mounting, calibration history, dynamic range, spatial sampling, temporal averaging, firmware, and data reduction influence the result differently. A number obtained during sound intensity and energy-flow localisation can be highly repeatable yet unrepresentative of the accessible receiving population, or representative yet still insufficient for the institutional decision.

Perform field checks, retain pressure-intensity indicators and repeat scans, segment the surface, and compare integrated power with room-level energy balances. Every evidence object used for sound intensity and energy-flow localisation should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.22 uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[741]

A visually striking intensity map can be unreliable where the field is strongly reactive or the probe phase error is comparable to the measured phase

741 MB-0598. David A. Bies, Colin H. Hansen, and Carl Q. Howard, Engineering Noise Control, 6th ed., 2024, Engineering Noise Control: Theory and Practice.

difference. The test plan for sound intensity and energy-flow localisation should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.22 has weight only when the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

Use intensity as one line of evidence and confirm candidate regions through intervention, inspection, or an independent measurement. The report states the scan surface, integration method, validity indicators, and unmeasured boundaries. The final statement for sound intensity and energy-flow localisation should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.22 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[742]

Table 36-5. Sound-intensity and vibration localisation quality controls

Control	Reason	Required record	Failure signature
Probe or transducer orientation	Direction and phase determine the measured vector or response	Axes, spacing, mounting, photographs, and coordinates	Sign reversal, implausible flow direction, or inconsistent repeats
Frequency range and spacing	Spatial aliasing and reactive-field error vary with wavelength	Band limits, spacer, correction, and method basis	High-frequency instability or low-frequency bias
Background and dynamic range	Low signal-to-background reduces localisation confidence	Source-on, source-off, residual, and correction rule	Patchy map dominated by noise or correction limit
Surface segmentation	Partial power depends on the chosen integration area	Grid, excluded edges, openings, and total area	Apparent path changes when arbitrary boundaries move
Synchronous reference	Vibration attribution requires relation to the source	Reference channel, coherence, averaging, and time alignment	Broad response without stable phase or operating-state relation

742 MB-0599. JCGM 100:2008.

Figure 36-5. A local response map identifies regions for further testing; it does not by itself prove a causal defect.

Worked example 36.36. Integrated sound power from intensity

Engineering question. What sound power follows from mean normal intensity 3.2 mW/m2 across a 7.5 m2 scan surface?

Variables and assumptions. I_n is mean normal intensity; s is surface area; w is acoustic power; l_W is power level re 1 pW.

Result and engineering significance. The integrated power is 0.0240 W, or 103.8 dB re 1 pW.

Limitation. Validity depends on complete surface coverage, phase accuracy, background, and reactive-field indicators.

36.23 Airflow, pressure-assisted inspection, and tracer methods

The decisive distinction is between observation and causal proof. Pressure and airflow interventions are powerful because they alter leakage mechanisms without necessarily opening the construction. Controlled pressurisation, differential-pressure logging, tracer release, flow visualisation, and reversible boundary isolation should be coordinated with HVAC state and life-safety constraints. The imposed condition must be distinguished from ordinary operation, and tracer behaviour should not be overinterpreted as a direct measure of speech transmission.

Measurement quality in Section 36.23 depends on the complete chain from measurand to final data product. Within Section 36.23, transducer mounting, calibration history, dynamic range, spatial sampling, temporal averaging, firmware, and data reduction influence the result differently. A number obtained during airflow, pressure-assisted inspection, and tracer methods can be highly repeatable yet unrepresentative of the accessible receiving population, or representative yet still insufficient for the institutional decision.

Record indoor and outdoor pressure, plant state, temperature, tracer identity, release location, detection method, time, and safety controls. Every evidence object used for airflow, pressure-assisted inspection, and tracer methods should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.23 uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[743]

Smoke movement can follow bulk airflow while high-frequency sound follows a smaller discontinuity; conversely, a porous path can pass sound without an obvious visible plume. The test plan for airflow, pressure-assisted inspection, and tracer methods should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.23 has weight only when the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

Use modest controlled pressure where authorised and interpret airflow evidence with acoustic measurements and construction detail. The

743 MB-0600. ASTM International, ASTM E779-19.

conclusion states whether a path was demonstrated for air, sound, or both. The final statement for airflow, pressure-assisted inspection, and tracer methods should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.23 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[744]

Worked example 36.37. Pressure-flow extrapolation

Engineering question. If measured leakage flow is 0.035 m3/s at 25 Pa with flow exponent 0.62, what flow is screened at 50 Pa?

Variables and assumptions. Q1 is measured flow at pressure Delta p1; n is flow exponent; q2 is estimated flow at Delta p2.

Result and engineering significance. The screened flow is 0.0538 m3/s.

Limitation. The extrapolation assumes stable path geometry and does not convert airflow directly into acoustic attenuation.

36.24 Thermography, optical inspection, and borescopes

Engineering judgement must remain traceable. Thermography, optical examination, and borescopes supply geometric and material evidence that complements rather than replaces acoustical testing. Temperature gradients, emissivity, reflections, access geometry, focus, illumination, and the risk of creating a new opening should be recorded so that images remain interpretable. An apparent thermal or visual discontinuity is a hypothesis about construction state, not proof of the dominant acoustic path.

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744 MB-0601. David A. Bies, Colin H. Hansen, and Carl Q. Howard, Engineering Noise Control, 6th ed., 2024, Engineering Noise Control: Theory and Practice.

Measurement quality in Section 36.24 depends on the complete chain from measurand to final data product. Within Section 36.24, transducer mounting, calibration history, dynamic range, spatial sampling, temporal averaging, firmware, and data reduction influence the result differently. A number obtained during thermography, optical inspection, and borescopes can be highly repeatable yet unrepresentative of the accessible receiving population, or representative yet still insufficient for the institutional decision.

Establish suitable boundary conditions, record camera settings and environmental data, preserve original radiometric files, calibrate scale, and photograph the insertion geometry. Every evidence object used for thermography, optical inspection, and borescopes should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.24 uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[745]

A cold line can indicate metal framing rather than a gap, while a cavity image can miss a discontinuity outside the viewing cone. The test plan for thermography, optical inspection, and borescopes should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.24 has weight only when the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

745 MB-0603. International Organization for Standardization, ISO 18436-7:2014.

Correlate anomalies with drawings, pressure or acoustic tests, and direct observation before assigning causal weight. Any opening created for inspection is documented, controlled, restored, and entered into the configuration baseline. The final statement for thermography, optical inspection, and borescopes should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.24 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[746]

Worked example 36.38. Thermal-contrast significance screen

Engineering question. A surface anomaly is 4.8 K relative to adjacent material. Camera and environmental standard uncertainties are 0.6 K and 1.1 K. What screening ratio results?

Variables and assumptions. Delta T is thermal contrast; u_cam and u_env are standard uncertainties; u is combined uncertainty; z is contrast ratio.

Result and engineering significance. The anomaly is 3.83 combined standard uncertainties from the local reference and merits investigation.

Limitation. Emissivity, reflections, moisture, framing, and airflow remain alternative explanations.

36.25 Controlled openings, sampling, and destructive examination

Controlled opening is an evidentiary intervention whose information value must justify physical damage, operational interruption, and the possibility of altering the mechanism. Sampling locations should be selected from

746 MB-0602. ASTM International, ASTM E1186-22.

competing hypotheses and documented before access, with photographs, dimensions, custody, restoration details, and comparison locations. A single opening cannot establish population-wide workmanship unless the sampling inference and common-cause evidence are separately supported.

Measurement quality in Section 36.25 depends on the complete chain from measurand to final data product. Within Section 36.25, transducer mounting, calibration history, dynamic range, spatial sampling, temporal averaging, firmware, and data reduction influence the result differently. A number obtained during controlled openings, sampling, and destructive examination can be highly repeatable yet unrepresentative of the accessible receiving population, or representative yet still insufficient for the institutional decision.

Prepare an opening plan with hypothesis, predicted observation, dimensions, services clearance, containment, witnesses, evidence identifiers, restoration detail, and stop conditions. Every evidence object used for controlled openings, sampling, and destructive examination should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.25 uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[747]

One clean opening does not validate an entire population, while one defective opening does not prove universal failure. The test plan for

747 MB-0604. National Institute of Standards and Technology, NIST/SEMATECH e-Handbook of Statistical Methods, Engineering statistics reference.

controlled openings, sampling, and destructive examination should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.25 has weight only when the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

Use stratified sampling and escalate according to pre-defined findings; retain removed materials when their condition matters. Closure records what was observed, what remained concealed, and how the repaired opening was recommissioned. The final statement for controlled openings, sampling, and destructive examination should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.25 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[748]

Table 36-6. Controlled-opening and physical-sampling plan

Planning field	Minimum content	Reason	Closure evidence
Authority and scope	Exact opening, purpose, information controls, safety permits, and stop conditions	Intrusive work can affect fire, structure, hazardous materials, and evidentiary integrity	Signed permit and approved restoration method
Pre-opening baseline	Dimensions, photographs, local acoustic or vibration response, system state	Enables comparison and prevents later uncertainty about pre-existing condition	Time-stamped record and coordinate map
Sample identity	Location, orientation, dimensions, material lot, tool, handler, and seal	Supports provenance and representativeness	Sample register and custody signature

748 MB-0605. United States Department of Defense, UFGS 01 45 00, Quality Control.

Planning field	Minimum content	Reason	Closure evidence
Observation protocol	Expected conditions, alternative hypotheses, negative evidence, and measurement sensitivity	Reduces confirmation bias during opening	Contemporaneous notes and independent witness where required
Restoration and retest	Compatible materials, hold points, inspection, cure, operational return, and verification	The investigation must not leave a new weakness	As-restored drawings, photographs, and state-matched retest

Worked example 36.39. Destructive-sampling screen

Engineering question. How many approximately independent openings are needed for a 95% chance of observing one condition present in 7% of opportunities?

Variables and assumptions. p is screened prevalence; c is desired detection confidence; n is sample count.

Result and engineering significance. The screen gives 42 openings, which should be stratified and adjusted for clustering and consequence.

Limitation. The prevalence is an assumption and the result does not justify unnecessary destructive work.

36.26 Evidence custody for files, photographs, and physical samples

Raw files, processed exports, photographs, logs, physical samples, instrument settings, software versions, hashes, time references, and derivation records should remain linked so that another competent examiner can reconstruct the analytical chain. Evidence custody must preserve technical meaning as well as legal identity. A checksum detects byte change; it does not prove that the file represents the correct location, configuration, or measurand.

Assign stable identifiers, record collection and transfer, preserve originals, hash digital files, document conversions, control access, and retain the software or method needed to interpret proprietary formats. Every evidence object used for evidence custody for files, photographs, and physical samples should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.26 uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[749]

A complete chain of custody does not prove relevance or accuracy, but a broken chain can prevent a reviewer from testing either. The test plan for evidence custody for files, photographs, and physical samples should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.26 has weight only when the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

Use derivative copies for analysis and preserve the source; record every annotation, crop, enhancement, resampling, or unit conversion. The final dossier distinguishes source evidence, demonstrative material, analytical output, and privileged or restricted records. The final statement for evidence

749 MB-0606. National Institute of Standards and Technology, FIPS PUB 180-4, Secure Hash Standard.

custody for files, photographs, and physical samples should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.26 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[750]

Worked example 36.40. Custody-transfer completeness

Engineering question. What transfer-record coverage exists when 139 of 146 evidence items have complete custody entries?

Variables and assumptions. N_c is items with complete transfer history; n_t is total items; c is coverage.

Result and engineering significance. Coverage is 95.21%. The seven exceptions must be individually explained and risk-assessed.

Limitation. A numerical coverage percentage does not determine admissibility or evidentiary weight.

36.27 Instrument selection, calibration, and field checks

Properly framed, instrument selection should follow the mechanism and required uncertainty rather than prestige, bandwidth, or nominal sensitivity. Calibration status, self-noise, dynamic range, phase response, overload, spatial response, environmental limits, field checks, and software configuration must be matched to the proposed observation. An instrument can be functioning correctly while being methodologically incapable of answering the question posed.

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750 MB-0607. United States Courts, Federal Rules of Evidence 702, 703, 705, and 901, Expert testimony, bases of opinion, disclosure, and authentication rules.

Measurement quality in Section 36.27 depends on the complete chain from measurand to final data product. Within Section 36.27, transducer mounting, calibration history, dynamic range, spatial sampling, temporal averaging, firmware, and data reduction influence the result differently. A number obtained during instrument selection, calibration, and field checks can be highly repeatable yet unrepresentative of the accessible receiving population, or representative yet still insufficient for the institutional decision.

Select equipment through a channel-by-channel plan, verify calibration certificates, perform pre- and post-checks, document drift, and retain serial numbers and firmware. Every evidence object used for instrument selection, calibration, and field checks should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.27 uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[751]

A class designation does not guarantee matched phase for intensity, low-noise performance, or immunity to radio-frequency interference in the actual setup. The test plan for instrument selection, calibration, and field checks should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.27 has weight only when the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

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751 MB-0609. International Electrotechnical Commission, IEC 61672-1:2013.

Use redundant checks or alternate instruments for consequential anomalies and investigate unexplained drift before continuing. The report records the complete measurement chain and any uncertainty or limitation introduced by field conditions. The final statement for instrument selection, calibration, and field checks should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.27 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[752]

Table 36-7. Instrument, calibration, and field-check matrix

Instrument or channel	Primary use	Critical controls	Evidence retained
Measurement microphone and analyser	Pressure levels, spectra, time history, transfer data	Class, sensitivity, self-noise, overload, field checks, firmware, bandwidth	Certificate, before and after checks, raw files, settings
Sound-intensity probe	Vector intensity and partial sound power	Spacer, phase calibration, residual-intensity index, orientation, surface distance	Probe configuration, verification, coordinates, quality indicators
Accelerometer or velocity transducer	Structure-borne response and source relation	Mounting, mass loading, axis, cable strain, calibration, noise floor	Photographs, orientation, certificate, raw channels, coherence
Pressure and airflow instruments	Differential pressure, flow, tracer interpretation	Range, zero, environmental correction, tubing, leakage, response time	Zero checks, calibration, layout, readings, state record
Thermal camera or borescope	Non-contact screening and concealed visual inspection	Emissivity, reflections, focus, scale, lighting, access, image metadata	Native imagery, settings, calibration or verification, location map
Digital collection workstation	Logs, firmware, configuration, photographs, analysis	Clock, write protection, software version, hashing, access, reproducibility	Tool version, manifest, hashes, processing history, derivatives

752 MB-0608. International Electrotechnical Commission, IEC 60942:2017.

Worked example 36.41. Acoustic field-check correction

Engineering question. A field calibrator nominally produces 94.0 dB and the channel reads 93.6 dB. What indicated correction is recorded?

Variables and assumptions. L_nom is calibrator nominal level; l_obs is observed level; c is indicated channel correction.

Result and engineering significance. The indicated correction is +0.4 dB, subject to the project method and calibration certificate.

Limitation. A one-frequency field check does not verify broadband response, phase, linearity, or self-noise.

36.28 Spatial, temporal, and operating-state sampling

The analytical burden is exacting. Sampling must represent spatial gradients, temporal variability, and operating-state diversity without creating a false appearance of exhaustive coverage. The plan should distinguish fixed monitoring, repeated positions, boundary scans, random or stratified samples, transient capture, and adverse-state observations, with independence assumptions stated. More observations do not cure systematic bias when the relevant state or path was never sampled.

Measurement quality in Section 36.28 depends on the complete chain from measurand to final data product. Within Section 36.28, transducer mounting, calibration history, dynamic range, spatial sampling, temporal averaging, firmware, and data reduction influence the result differently. A number obtained during spatial, temporal, and operating-state sampling can be highly repeatable yet unrepresentative of the accessible receiving population, or representative yet still insufficient for the institutional decision.

Define strata, random or systematic elements, minimum spacing, dwell time, repeat count, state sequence, and rules for missing or censored observations. Every evidence object used for spatial, temporal, and operating-state sampling should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.28 uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[753]

Treating correlated measurements as independent understates uncertainty and can create false precision. The test plan for spatial, temporal, and operating-state sampling should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.28 has weight only when the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

Use pilot data to estimate variability and adapt the design without concealing the adaptation. The sampling record permits another engineer to understand both what the data represent and what they do not represent. The final statement for spatial, temporal, and operating-state sampling should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.28 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[754]

753 MB-0610. ASTM International, ASTM E336-25a.
754 MB-0611. JCGM 100:2008.

Worked example 36.42. Effective sample size under spatial correlation

Engineering question. Eight nearby measurements have an estimated common correlation of 0.55. What design-effect screen applies?

Variables and assumptions. m is measurements per cluster; rho is intra-cluster correlation; d is design effect; n_eff is effective independent count.

Result and engineering significance. Eight readings provide only about 1.65 independent-equivalent observations under the simple cluster model.

Limitation. The exchangeable-correlation assumption is a screen; spatial covariance should be examined directly where material.

36.29 Dynamic range, background correction, and censored data

This inquiry should be treated as a coupled physical and evidentiary problem. Censored and background-limited data require explicit treatment because ordinary subtraction and averaging can produce fictitious precision near the measurement floor. The report should identify overload, under-range, non-detects, background corrections, confidence limits, and any bands excluded from inference, while retaining the raw observations. A numerical value generated by software is not necessarily a measured value when the signal was indistinguishable from background.

Measurement quality in Section 36.29 depends on the complete chain from measurand to final data product. Within Section 36.29, transducer mounting, calibration history, dynamic range, spatial sampling, temporal averaging, firmware, and data reduction influence the result differently. A number obtained during dynamic range, background correction, and censored data can be highly repeatable yet unrepresentative of the accessible receiving population, or representative yet still insufficient for the institutional decision.

Preserve source-on and source-off data, apply only method-permitted corrections, record correction magnitude, and report bounds where subtraction becomes unstable. Every evidence object used for dynamic range, background correction, and censored data should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.29 uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[755]

Discarding low-margin bands or replacing them with optimistic values biases the result toward apparent success. The test plan for dynamic range, background correction, and censored data should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.29 has weight only when the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

Increase source stability, reduce unrelated background lawfully, change geometry where permitted, or state a lower bound rather than inventing resolution. Decision rules must account for censored bands and cannot treat an unmeasurable result as proof of high isolation. The final statement for

755 MB-0612. International Organization for Standardization, ISO 12999-1:2020.

dynamic range, background correction, and censored data should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.29 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[756]

Worked example 36.43. Censored receiving-band bound

Engineering question. A source-on band is 47 dB and background is 45 dB, below the adopted correction margin. How should the source contribution be reported?

Variables and assumptions. L_total is source-on total; l_background is source-off level; the 2 dB margin is insufficient for stable energetic subtraction.

Result and engineering significance. The band is reported as censored with an upper bound, not as a precise corrected source level.

Limitation. A lower bound on attenuation may be possible if source level and geometry are known, but the method limit must remain visible.

36.30 Causal attribution and competing explanations

A defensible examination begins from a bounded proposition. Causal attribution is a structured comparison among explanations, not a rhetorical preference for the first plausible defect. Mechanism, temporal sequence, spatial pattern, intervention response, dose or state dependence, alternative causes, and falsifying observations should be assembled in a transparent causal matrix. Convergent evidence can support a conclusion

756 MB-0613. JCGM 106:2012.

without eliminating every theoretical possibility, but residual alternatives must be stated proportionately.

Section 36.30 keeps observation, model, and judgement separate. For Section 36.30, the model simplifies the room, while the judgement explains how strongly the observed contrasts support one mechanism over its alternatives. For causal attribution and competing explanations, configuration uncertainty, inaccessible construction, state mismatch, and model discrepancy may outweigh the narrow calibration uncertainty attached to the instrument display.

Create a hypothesis matrix with predictions, falsifiers, supporting evidence, contrary evidence, missing evidence, and confidence. Every evidence object used for causal attribution and competing explanations should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.30 uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[757]

Chronology, correlation, and successful repair each add weight but can mislead when collateral variables change or several defects coexist. The test plan for causal attribution and competing explanations should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.30 has weight only

757 MB-0616. ASTM International, ASTM E3176-24.

when the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

Use converging independent evidence, controlled interventions, negative findings, and sensitivity analysis before assigning responsibility. The conclusion is expressed at a level of confidence supported by the record and avoids legal characterisations outside the technical remit. The final statement for causal attribution and competing explanations should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.30 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[758]

Figure 36-6. A controlled intervention gains causal value only when its prediction, collateral variables, negative evidence, and alternative explanations are recorded.

Worked example 36.44. Likelihood ratio for a discriminating observation

Engineering question. A diagnostic observation occurs in 82% of confirmed gap cases and 12% of non-gap cases in a relevant validation set. What positive likelihood ratio follows?

Variables and assumptions. Se is sensitivity; FPR is false-positive rate; LR+ is positive likelihood ratio.

Result and engineering significance. The observation multiplies prior odds by about 6.83 under the validation assumptions.

Limitation. Transferability, case selection, dependence on other evidence, and spectrum of alternative defects must be examined.

758 MB-0617. International Organization for Standardization, ISO 31000:2018.

36.31 Bayesian and likelihood reasoning without false precision

The decisive distinction is between observation and causal proof. Bayesian and likelihood reasoning are most useful here as disciplines for updating comparative plausibility, not as ornaments of false numerical exactitude. Prior information, test sensitivity, specificity, conditional dependence, and the evidentiary meaning of a positive or negative result should be declared before probabilities are combined. When defensible numerical priors do not exist, ordinal likelihood reasoning and explicit assumptions are preferable to fabricated precision.

Section 36.31 keeps observation, model, and judgement separate. For Section 36.31, the model simplifies the room, while the judgement explains how strongly the observed contrasts support one mechanism over its alternatives. For bayesian and likelihood reasoning without false precision, configuration uncertainty, inaccessible construction, state mismatch, and model discrepancy may outweigh the narrow calibration uncertainty attached to the instrument display.

Use qualitative or bounded likelihood ratios where data are weak, document assumptions, and show how conclusions change across plausible inputs. Every evidence object used for bayesian and likelihood reasoning without false precision should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.31 uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[759]

759 MB-0619. International Organization for Standardization, ISO 31000:2018.

Multiplying dependent evidence as though it were independent can exaggerate confidence by orders of magnitude. The test plan for bayesian and likelihood reasoning without false precision should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.31 has weight only when the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

Prefer transparent ranges, scenario tables, and sensitivity plots over a single posterior probability unsupported by data. The report explains how the evidence changes relative support among hypotheses rather than claiming mathematical proof. The final statement for bayesian and likelihood reasoning without false precision should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.31 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[760]

Worked example 36.45. Bounded Bayesian update

Engineering question. With prior probability 0.25 and positive likelihood ratio 6.83, what posterior probability results under the stated model?

Variables and assumptions. P0 is prior probability; o0 is prior odds; LR is likelihood ratio; p1 is posterior probability.

Result and engineering significance. The model yields posterior probability 0.695. The transparent assumptions are more important than the apparent precision.

760 MB-0618. ASTM International, ASTM E2713-25.

Limitation. The result is invalid if the prior or likelihood ratio is invented or if evidence dependence is ignored.

36.32 Uncertainty, configuration uncertainty, and model discrepancy

Engineering judgement must remain traceable. Measurement uncertainty is only one component of the inferential problem; configuration uncertainty and model discrepancy may dominate. The analysis should separate repeatability, calibration, spatial sampling, environmental effects, source stability, processing, unknown construction, and mismatch between the model and installed system. A narrow instrumental uncertainty cannot validate a conclusion whose physical state is poorly known.

Section 36.32 keeps observation, model, and judgement separate. For Section 36.32, the model simplifies the room, while the judgement explains how strongly the observed contrasts support one mechanism over its alternatives. For uncertainty, configuration uncertainty, and model discrepancy, configuration uncertainty, inaccessible construction, state mismatch, and model discrepancy may outweigh the narrow calibration uncertainty attached to the instrument display.

Separate quantified measurement uncertainty from configuration uncertainty, model discrepancy, and unresolved alternatives; do not combine unlike quantities merely to produce one number. Every evidence object used for uncertainty, configuration uncertainty, and model discrepancy should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.32 uses measurement files, the retained record should include raw channels, analysis settings, calibration,

environmental observations, processing history, and the exact operating state rather than only a selected plot.[761]

A small instrument uncertainty can coexist with a large uncertainty about whether the tested state matches the event. The test plan for uncertainty, configuration uncertainty, and model discrepancy should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.32 has weight only when the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

Use uncertainty budgets for measurable quantities and structured confidence statements for non-probabilistic gaps. Closure identifies which uncertainties affect the numerical result, the causal inference, and the authority decision. The final statement for uncertainty, configuration uncertainty, and model discrepancy should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.32 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[762]

Table 36-8. Uncertainty and discrepancy components in a forensic conclusion

Component	Illustrative source	Treatment	Reporting consequence
Measurement uncertainty	Calibration, repeatability, positioning, background, environmental correction	Quantify through a stated measurement model where practicable	Report standard or expanded uncertainty and coverage basis

761 MB-0620. International Organization for Standardization, ISO 12999-1:2020.
762 MB-0621. JCGM 106:2012.

Component	Illustrative source	Treatment	Reporting consequence
Configuration uncertainty	Unknown seal state, concealed support, firmware, door pressure, inaccessible space	Bound by scenarios, additional inspection, sensitivity, or explicit open issue	Do not hide inside a narrow instrument uncertainty
Model discrepancy	Idealised gap, diffuse-field assumption, linear path model, simplified source	Compare with residuals, interventions, and alternate models	State where the model is explanatory rather than predictive
Sampling uncertainty	Limited rooms, positions, times, crews, lots, or operating states	Stratify, randomise where appropriate, and disclose population limits	Restrict population-level claims
Decision uncertainty	Guard band, false-accept and false-reject consequences, authority tolerance	Use a declared rule before observing the result	Separate technical result from final authority decision

Worked example 36.46. Combined measurement uncertainty

Engineering question. What combined and expanded uncertainty follows from four independent standard components of 0.7, 0.9, 0.6, and 1.3 dB?

Variables and assumptions. u_i are standard uncertainty components; u_c is combined standard uncertainty; u is expanded uncertainty with k=2.

Result and engineering significance. The combined standard uncertainty is 1.83 dB and the illustrative expanded uncertainty is 3.66 dB.

Limitation. Independence and coverage factor require justification; configuration uncertainty is not included.

36.33 Residual risk and unverified conditions

Residual risk is the technically and institutionally bounded remainder after verified corrective action, not a euphemism for unexamined conditions. Open paths, inaccessible zones, untested states, model limitations, deferred work, monitoring controls, and reopening triggers should be stated in a form that the decision authority can act upon. Absence of demonstrated exploitation is not equivalent to absence of vulnerability.

Section 36.33 keeps observation, model, and judgement separate. For Section 36.33, the model simplifies the room, while the judgement explains how strongly the observed contrasts support one mechanism over its alternatives. For residual risk and unverified conditions, configuration uncertainty, inaccessible construction, state mismatch, and model discrepancy may outweigh the narrow calibration uncertainty attached to the instrument display.

Record each open condition, consequence, likelihood basis, existing control, owner, due date, trigger, and authority disposition. Every evidence object used for residual risk and unverified conditions should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.33 uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[763]

Calling all untested conditions low risk without a stated basis converts absence of evidence into evidence of absence. The test plan for residual risk and unverified conditions should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.33 has weight only when the method

763 MB-0622. ASHRAE Standard 230-2022.

possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

Use conservative bounds and operational restrictions where verification is not practicable. The residual-risk register remains active until accepted, mitigated, tested, or formally transferred. The final statement for residual risk and unverified conditions should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.33 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[764]

Worked example 36.47. Residual-risk priority

Engineering question. What bounded residual-risk score follows from likelihood index 0.18, consequence index 9, and control effectiveness 0.60?

Variables and assumptions. L is likelihood index; c is consequence index; e is control effectiveness; r is residual score.

Result and engineering significance. The planning score is 0.648 and can be compared with other open issues under the same scale.

Limitation. The score is ordinal unless likelihood, consequence, and effectiveness are empirically calibrated.

36.34 Remedial design from a verified mechanism

The design record should connect the diagnosed path to materials, geometry, support conditions, sequencing, inspection points, acceptance measurements, and maintainability. Remedial design should intervene in

764 MB-0623. Office of the Director of National Intelligence, Technical Specifications for Construction and Management of Sensitive Compartmented Information Facilities, Version 1.5.1, Public SCIF technical specifications.

the verified mechanism while preserving structural, fire, moisture, accessibility, operational, and security obligations. A generic increase in mass or sealant quantity may add cost while leaving the controlling flank untouched.

A Section 36.34 remedy changes a coupled building system rather than one isolated acoustic number. An intervention for remedial design from a verified mechanism may improve one path while altering fire resistance, smoke control, structural restraint, moisture behaviour, accessibility, ventilation, maintenance access, or electronic operation. For Section 36.34, the verified mechanism, expected band-by-band benefit, collateral obligations, inspection points, and state-matched retest conditions should be written before construction begins.

Translate the finding into performance requirements, drawings, materials, workmanship, hold points, submittals, mock-ups, tests, and restoration requirements. Every evidence object used for remedial design from a verified mechanism should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.34 uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[765]

Adding mass to a wall will not cure a door gap, and sealing a sleeve can worsen vibration if rigid contact is introduced. The test plan for remedial design from a verified mechanism should name at least one alternative

765 MB-0625. United States Department of Defense, UFGS 01 45 00, Quality Control.

explanation and record the observation expected under each competing model. Negative evidence in Section 36.34 has weight only when the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

Use a path budget and collateral-obligation review before selecting the remedy; commission first-of-type work before repetition. The design basis states the mechanism addressed, expected band-specific effect, limitations, and verification method. The final statement for remedial design from a verified mechanism should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.34 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[766]

Table 36-9. Remedial-design selection and collateral obligations

Verified mechanism	Candidate remedy	Collateral obligations	Verification
Door perimeter leakage	Frame repair, seal replacement, threshold correction, alignment, or pressure adjustment	Fire listing, egress, accessibility, closing force, durability, security hardware	Contact map, operating force, local scan, room-pair and occupied-state retest
Duct cross-talk or breakout	Silencer, reroute, lining, breakout lagging, branch separation, or terminal change	Airflow, pressure loss, regenerated noise, fire or smoke damper, maintenance access	Flow balance, insertion or field contrast, background, and complete-room test
Rigid structural bridge	Isolate support, alter attachment, add break, or relocate service	Structural capacity, seismic restraint, fatigue, fire, maintenance, settlement	Mobility or transfer measurement and state-matched acoustic retest
Penetration or firestop weakness	Rebuild approved penetration system and acoustic closure	Listing, annulus, fill, backing, movement, inspection, identification	Hold-point inspection, photographs, leakage screening, acoustic retest

766 MB-0624. David A. Bies, Colin H. Hansen, and Carl Q. Howard, Engineering Noise Control, 6th ed., 2024, Engineering Noise Control: Theory and Practice.

Verified mechanism	Candidate remedy	Collateral obligations	Verification
Masking or background dependence	Restore, redesign, monitor, zone, or impose operating restriction	Occupational comfort, accessibility, alarms, power, controls, cyber, maintenance	Spectrum, uniformity, quiet-hour state, fault alarm, and speech consequence

Worked example 36.48. Expected remedial value

Engineering question. A verified remedy costs 78,000 dollars and is expected to avoid 55% of a 260,000 dollar consequence. What simple expected net value results?

Variables and assumptions. C_r is remedy cost; pB is expected avoided consequence; v is net expected value.

Result and engineering significance. The simple expected net value is 65,000 dollars before lifecycle and collateral costs.

Limitation. Decision authority, non-monetary consequences, uncertainty, and mandatory obligations can dominate this screen.

36.35 Dominant-path migration and path budgets

Properly framed, path dominance migrates as successful repairs suppress one contribution and expose another previously masked route. A band- and state-specific path budget should be updated after each substantial intervention, using energetic bounds and controlled retesting to estimate the maximum remaining benefit of further work. The emergence of a second path is not evidence that the first repair failed; it is an expected property of a parallel network.

A Section 36.35 remedy changes a coupled building system rather than one isolated acoustic number. An intervention for dominant-path migration and path budgets may improve one path while altering fire resistance, smoke control, structural restraint, moisture behaviour, accessibility, ventilation, maintenance access, or electronic operation. For Section 36.35, the verified mechanism, expected band-by-band benefit, collateral obligations, inspection points, and state-matched retest conditions should be written before construction begins.

Estimate path contributions with measured contrasts, models, intensity, vibration, or bounding assumptions, then update the budget after each intervention. Every evidence object used for dominant-path migration and path budgets should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.35 uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[767]

A large local improvement can yield a small room-level change if another path was already comparable. The test plan for dominant-path migration and path budgets should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.35 has weight only when the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

Sequence work to avoid over-investing in a path that will cease to control and verify the new dominant path after repair. The final acceptance record reports complete-envelope performance, not only the repaired component.

767 MB-0627. JCGM 100:2008.

The final statement for dominant-path migration and path budgets should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.35 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[768]

Figure 36-7. After a successful local repair, another path may become the system limit and must be measured rather than assumed.

Worked example 36.49. Dominant-path migration

Engineering question. What whole-system change follows when the door path improves from 42 to 58 dB while other path estimates change only slightly?

Variables and assumptions. R_i are path attenuations; r_total is energetic combination of parallel paths.

Result and engineering significance. The whole-system screen improves by only 5.4 dB because another path becomes controlling.

Limitation. Path estimates must share compatible references, and coherent coupling can violate simple energetic addition.

36.36 Temporary controls and reversible protective measures

The analytical burden is exacting. Temporary controls should reduce immediate consequence while remaining reversible, documented, inspectable, and distinguishable from the accepted configuration. Operational restrictions, supplemental masking, access controls, temporary seals, altered schedules, or monitoring can be proportionate pending permanent work. A temporary measure must carry an owner, expiry, failure

768 MB-0626. ASTM International, ASTM E336-25a.

mode, and verification plan or it will quietly become an undocumented baseline.

A Section 36.36 remedy changes a coupled building system rather than one isolated acoustic number. An intervention for temporary controls and reversible protective measures may improve one path while altering fire resistance, smoke control, structural restraint, moisture behaviour, accessibility, ventilation, maintenance access, or electronic operation. For Section 36.36, the verified mechanism, expected band-by-band benefit, collateral obligations, inspection points, and state-matched retest conditions should be written before construction begins.

Specify the control, responsible person, start and expiry, inspection frequency, failure indication, restoration, and conditions requiring escalation. Every evidence object used for temporary controls and reversible protective measures should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.36 uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[769]

A temporary treatment can become an undocumented permanent condition or alter evidence needed for diagnosis. The test plan for temporary controls and reversible protective measures should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.36 has weight only when the

769 MB-0629. International Organization for Standardization, ISO 9001:2015.

method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

Use the least intrusive measure that controls the identified risk and preserve the original state through records or samples before installation. Temporary controls are removed, replaced, or formally accepted at a defined decision point. The final statement for temporary controls and reversible protective measures should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.36 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[770]

Worked example 36.50. Temporary-control availability

Engineering question. A temporary control passes 12 of 14 scheduled inspections. What observed availability should be reported?

Variables and assumptions. N_p is passing inspections; n_t is total inspections; a is observed availability.

Result and engineering significance. Observed availability is 85.7%, demonstrating that nominal effectiveness is not continuous effectiveness.

Limitation. Inspection intervals can miss short failures and the sample does not establish future reliability.

36.37 Repair construction surveillance and hold points

This inquiry should be treated as a coupled physical and evidentiary problem. Repair surveillance is essential because the decisive conditions are frequently concealed before final testing. First-of-type work, materials,

770 MB-0628. ASHRAE Standard 230-2022.

interfaces, fasteners, clearances, seals, supports, photographs, hold points, nonconformances, and restoration should be recorded against stable identifiers. Improved sound data cannot legitimate a repair that compromised fire resistance, structure, moisture control, or another protected function.

A Section 36.37 remedy changes a coupled building system rather than one isolated acoustic number. An intervention for repair construction surveillance and hold points may improve one path while altering fire resistance, smoke control, structural restraint, moisture behaviour, accessibility, ventilation, maintenance access, or electronic operation. For Section 36.37, the verified mechanism, expected band-by-band benefit, collateral obligations, inspection points, and state-matched retest conditions should be written before construction begins.

Define preparatory, first-work, follow-up, witness, and hold points; identify required photographs, dimensions, samples, and signatures. Every evidence object used for repair construction surveillance and hold points should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.37 uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[771]

End-of-work testing may reveal failure without showing where workmanship departed from the detail. The test plan for repair construction surveillance

771 MB-0631. International Organization for Standardization, ISO 10005:2018.

and hold points should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.37 has weight only when the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

Use first-of-type inspection, stop-work authority, nonconformance records, and reinspection before concealment. The surveillance dossier is linked to the exact room, location, detail, crew, material lot, and date. The repair surveillance plan should use the hold-point and concealed-work controls established in Chapter 34. The final statement for repair construction surveillance and hold points should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.37 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[772]

Worked example 36.51. Hold-point detection screen

Engineering question. How many approximately independent first-of-type or follow-up inspections are needed for a 90% chance of detecting a defect present in 10% of opportunities?

Variables and assumptions. p is screened prevalence; c is target detection confidence; n is inspection count.

Result and engineering significance. The screen gives 22 inspections, to be stratified by crew, detail, location, and material lot.

772 MB-0630. ASTM International, ASTM E2174-24.

Limitation. Mandatory hold points and high-consequence details may require 100% inspection regardless of the sample calculation.

36.38 Configuration control and change management

A defensible examination begins from a bounded proposition. Configuration control gives continuing meaning to an earlier measurement by linking it to the exact physical, electronic, and operational state tested. Drawings, penetration registers, asset identifiers, set points, software, maintenance, approvals, and as-operated conditions should be reconciled through a controlled change process. A room name or accreditation record does not freeze the system against later alterations.

A Section 36.38 remedy changes a coupled building system rather than one isolated acoustic number. An intervention for configuration control and change management may improve one path while altering fire resistance, smoke control, structural restraint, moisture behaviour, accessibility, ventilation, maintenance access, or electronic operation. For Section 36.38, the verified mechanism, expected band-by-band benefit, collateral obligations, inspection points, and state-matched retest conditions should be written before construction begins.

Maintain a baseline register, change request, impact screen, approval route, installation evidence, verification requirement, and updated drawings. Every evidence object used for configuration control and change management should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.38 uses measurement files, the retained record should include raw channels, analysis settings, calibration,

environmental observations, processing history, and the exact operating state rather than only a selected plot.[773]

Classifying work by cost or visual size misses small changes with large acoustic or security consequence. The test plan for configuration control and change management should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.38 has weight only when the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

Screen every change against source, path, receiver, listener access, evidence, and authority. The room is returned to service only when the change record and any required recommissioning are complete. The final statement for configuration control and change management should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.38 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[774]

Table 36-10. Configuration-change triggers and required response

Change event	Potential acoustic consequence	Minimum review	Recommissioning response
New cable, conduit, pipe, sprinkler, or sleeve work	Air path, rigid bridge, firestop disturbance, added source	Penetration permit, as-built location, materials, inspection	Local and system-level test based on affected path
Door hardware, seal, frame, floor finish, or pressure change	Contact geometry, threshold gap, operating force, pressure-assisted leakage	Door schedule, force and gap checks, authority review	Door and adjacent whole-room verification

773 MB-0632. International Organization for Standardization, ISO 9001:2015.
774 MB-0633. Office of the Director of National Intelligence, Technical Specifications for Construction and Management of Sensitive Compartmented Information Facilities, Version 1.5.1, Public SCIF technical specifications.

Change event	Potential acoustic consequence	Minimum review	Recommissioning response
HVAC balancing, filter, damper, fan, controls, or schedule change	Duct transmission, background, pressure, vibration, quiet-state exposure	Plant-state comparison, logs, airflow, noise and pressure measurements	Retest credible high-risk operating states
Masking, conferencing, sensor, firmware, or network change	Changed source, background, processing, logs, failure modes, cyber interface	Configuration export, approved version, functional and fault test	Occupied-state and failure-state verification
Structural, façade, ceiling, access floor, or tenant alteration	Flanking, junction, cavity, support, access and neighbouring-state changes	Drawing and site review, hold points, baseline comparison	Targeted plus complete-envelope recommissioning

Worked example 36.52. Configuration-change consequence index

Engineering question. What transparent screening score follows from seven physical, five digital, four operational, and two authority-impact changes?

Variables and assumptions. N_i are counts by change class; w_i are consequence-screen weights; c is the index.

Result and engineering significance. The index is 47, indicating the change package requires multidisciplinary review and likely recommissioning.

Limitation. Weights are project-specific and the index does not replace detailed impact analysis.

36.39 Periodic recommissioning and trend analysis

The decisive distinction is between observation and causal proof. Periodic recommissioning should be risk-based, state-aware, and informed by trend evidence rather than imposed as an arbitrary calendar ritual. Door leakage, masking performance, plant states, penetrations, vibration indicators, complaints, maintenance history, and prior uncertainty can be used to select targeted tests and escalation thresholds. Trend lines are meaningful only when methods and configurations remain comparable.

A Section 36.39 remedy changes a coupled building system rather than one isolated acoustic number. An intervention for periodic recommissioning and trend analysis may improve one path while altering fire resistance, smoke control, structural restraint, moisture behaviour, accessibility, ventilation, maintenance access, or electronic operation. For Section 36.39, the verified mechanism, expected band-by-band benefit, collateral obligations, inspection points, and state-matched retest conditions should be written before construction begins.

Define stable indicators, reference states, control limits, seasonal windows, trend methods, inspection intervals, and event triggers. Every evidence object used for periodic recommissioning and trend analysis should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.39 uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[775]

A statistically significant trend can be operationally trivial, while a small repeated adverse shift can be consequential near a decision boundary. The test plan for periodic recommissioning and trend analysis should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.39 has

775 MB-0635. National Institute of Standards and Technology, NIST/SEMATECH e-Handbook of Statistical Methods, Engineering statistics reference.

weight only when the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

Investigate outliers and cumulative patterns with the same state discipline used for acceptance. Trend records support maintenance and escalation but do not replace full testing after material change. The final statement for periodic recommissioning and trend analysis should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.39 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[776]

Worked example 36.53. EWMA trend indicator

Engineering question. What exponentially weighted moving average follows from prior EWMA 51.4 dB, new observation 49.8 dB, and weighting factor 0.25?

Variables and assumptions. lambda is weighting factor; x_t is current observation; z_prev is prior EWMA; z_t is updated EWMA.

Result and engineering significance. The updated EWMA is 51.00 dB, moving adversely from the 52 dB reference.

Limitation. Control limits must reflect stable-state variability and the EWMA is a trigger, not an automatic security conclusion.

776 MB-0634. JCGM 106:2012.

36.40 Before-and-after comparison and decision rules

Engineering judgement must remain traceable. Before-and-after comparison requires a declared decision rule that distinguishes technical change from measurement scatter and configuration mismatch. Paired observations, covariance, guard bands, effect size, relevant frequency bands, and operational significance should be considered together rather than reduced to one favourable average. Statistical significance cannot substitute for engineering relevance, and a large change cannot be interpreted without confirming what else changed.

A Section 36.40 remedy changes a coupled building system rather than one isolated acoustic number. An intervention for before-and-after comparison and decision rules may improve one path while altering fire resistance, smoke control, structural restraint, moisture behaviour, accessibility, ventilation, maintenance access, or electronic operation. For Section 36.40, the verified mechanism, expected band-by-band benefit, collateral obligations, inspection points, and state-matched retest conditions should be written before construction begins.

State the acceptance limit, guard band, uncertainty model, correlation assumptions, missing-data rule, and required bands before reviewing the result. Every evidence object used for before-and-after comparison and decision rules should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.40 uses measurement files, the retained record should include raw channels, analysis settings, calibration,

environmental observations, processing history, and the exact operating state rather than only a selected plot.[777]

Selecting favourable positions or bands after seeing the data converts verification into advocacy. The test plan for before-and-after comparison and decision rules should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.40 has weight only when the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

Preserve both raw data sets, show all material changes, and distinguish improvement, compliance, and authority to use. The decision record names the rule applied and the risk of false acceptance or rejection. Before-and-after testing should be executed under the metrology and commissioning controls stated in Chapter 35. The final statement for before-and-after comparison and decision rules should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.40 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[778]

Worked example 36.54. Guard-band decision

Engineering question. A measured result is 52.8 dB with expanded uncertainty 2.4 dB. Under a one-standard-uncertainty guard band against a 50 dB minimum, what decision value results?

777 MB-0639. International Organization for Standardization, ISO 12999-1:2020.
778 MB-0638. ASTM International, ASTM E336-25a.

Variables and assumptions. y is result; u is expanded uncertainty for k=2; g is one-standard-uncertainty guard band; y_d is decision value.

Result and engineering significance. The decision value is 51.6 dB, above the illustrative 50 dB minimum.

Limitation. The adopted rule, coverage factor, conformity risk, band requirements, and authority criteria control the real decision.

36.41 Recommissioning dossier and authority closure

The recommissioning dossier is the evidentiary bridge between corrective work and the authority's lifecycle decision. It should integrate the original issue, preserved baseline, causal analysis, design disposition, surveillance, raw and processed test data, uncertainty, residual risk, operating conditions, and future triggers. Technical closure and authority closure are distinct acts and should bear separate signatures and scopes.

A Section 36.41 remedy changes a coupled building system rather than one isolated acoustic number. An intervention for recommissioning dossier and authority closure may improve one path while altering fire resistance, smoke control, structural restraint, moisture behaviour, accessibility, ventilation, maintenance access, or electronic operation. For Section 36.41, the verified mechanism, expected band-by-band benefit, collateral obligations, inspection points, and state-matched retest conditions should be written before construction begins.

Use controlled identifiers, signatures, revision history, access restrictions, checksums, and a final configuration index. Every evidence object used for recommissioning dossier and authority closure should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.41 uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[779]

A technically persuasive report can still fail operationally if records, drawings, training, spares, monitoring, or authority actions are incomplete. The test plan for recommissioning dossier and authority closure should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.41 has weight only when the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

Review the dossier for technical sufficiency, information handling, contractual closure, and operational readiness. Only the competent authority grants the relevant approval; the engineer states the evidence and limitations. The final statement for recommissioning dossier and authority closure should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.41 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[780]

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779 MB-0640. National Institute of Standards and Technology, FIPS PUB 180-4, Secure Hash Standard.
780 MB-0641. Office of the Director of National Intelligence, Technical Specifications for Construction and Management of Sensitive Compartmented Information Facilities, Version 1.5.1, Public SCIF technical specifications.

Table 36-11. Recommissioning dossier and authority-closure fields

Dossier field	Minimum content	Responsible evidence source	Closure question
Finding and authorised scope	Identifier, reporter, protected function, decision owner, information controls	Incident record, engagement, authority correspondence	What question was authorised and what was excluded?
Configuration baseline	As-designed, as-built, as-accepted, as-operated, and examination changes	Drawings, registers, logs, photographs, interviews	What system and states were actually investigated?
Hypotheses and methods	Competing mechanisms, predictions, methods, instruments, sampling, and deviations	Evidence map, test plan, raw-data register	Why were these observations collected and were they sensitive enough?
Findings and uncertainty	Results, negative evidence, uncertainty, model limitations, residual alternatives	Calculations, plots, quality review, independent checking	What conclusion is supported and how strongly?
Remedy and verification	Design basis, collateral obligations, inspection, state-matched before and after tests	Design records, hold points, commissioning package	Did the work address the verified mechanism without creating another weakness?
Lifecycle disposition	New baseline, open issues, triggers, inspection interval, authority signature, record location	Change register, maintenance system, final report	Who accepted the residual risk and when must the proposition be reopened?

Figure 36-8. Technical closure must produce a recoverable dossier, a new baseline, lifecycle triggers, and an authority disposition.

Worked example 36.55. Recommissioning-dossier completeness

Engineering question. What bounded dossier score follows when 55 of 62 required items are complete and five are conditionally complete?

Variables and assumptions. N_c is complete items; n_q is conditional items; n_r is required items; c is bounded score.

Result and engineering significance. The bounded score is 0.927; the two missing and five conditional items remain explicitly listed.

Limitation. The score does not allow a mandatory authority signature or critical test record to be averaged away.

36.42 Contract disputes, allocation of responsibility, and records

Responsibility should be analysed through requirements, scope boundaries, submittals, coordination records, concealed-work evidence, notices, causation, mitigation, and the distinction between defect and consequential performance. Contract disputes often arise because each discipline can demonstrate local compliance while no party owns the complete source-to-receiver path. The investigator should avoid legal conclusions beyond the engagement while preserving the technical facts needed by counsel and the decision forum.

Work under Section 36.42 may later be examined by counsel, an owner, an authority, an insurer, a tribunal, or an independent reviewer. The record for contract disputes, allocation of responsibility, and records must consequently distinguish observation, calculation, inference, assumption, and opinion without disguising uncertainty. For Section 36.42, this technical treatment is not legal advice; the actual matter requires separate determination of procedural rules, privilege, protective orders, disclosure duties, and the governing authority.

Create a chronology and requirement matrix that links each technical issue to documents and actions without assuming the legal effect of the contract. Every evidence object used for contract disputes, allocation of responsibility, and records should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.42 uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[781]

A defect can have several contributing causes and several responsible actors; an engineer should not collapse that complexity into a legal conclusion. The test plan for contract disputes, allocation of responsibility, and records should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.42 has weight only when the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

State technical departures, causal mechanisms, foreseeable consequences, and evidentiary gaps while deferring legal interpretation to counsel or tribunal. The record preserves contrary evidence and identifies opinions dependent on disputed facts. Institutional responsibility must be interpreted within the public-source boundaries developed in Chapters 28 through 32. The final statement for contract disputes, allocation of responsibility, and records should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.42 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[782]

781 MB-0643. United States Courts, Federal Rules of Evidence 702, 703, 705, and 901, Expert testimony, bases of opinion, disclosure, and authentication rules.
782 MB-0642. United States Courts, Federal Rules of Civil Procedure 26.

Worked example 36.56. Technical contribution allocation

Engineering question. A causal model assigns bounded contribution weights 0.45 to design, 0.30 to installation, 0.15 to maintenance, and 0.10 to later alteration. Do the weights form a complete technical allocation?

Variables and assumptions. w_i are bounded technical contribution weights; s is their sum.

Result and engineering significance. The weights sum to one and can be used for sensitivity analysis of the technical narrative.

Limitation. They are not legal percentages of liability and remain dependent on disputed facts and model assumptions.

36.43 Expert evidence and report architecture

Properly framed, expert reporting should expose the inferential architecture so that observations, calculations, assumptions, opinions, and authority decisions cannot be mistaken for one another. Methods, data provenance, limitations, alternatives, uncertainty, exhibits, and the relationship between local findings and whole-room conclusions should be organised for independent scrutiny. Advocacy that exceeds the evidence weakens both technical credibility and admissibility.

Work under Section 36.43 may later be examined by counsel, an owner, an authority, an insurer, a tribunal, or an independent reviewer. The record for expert evidence and report architecture must consequently distinguish observation, calculation, inference, assumption, and opinion without disguising uncertainty. For Section 36.43, this technical treatment is not legal advice; the actual matter requires separate determination of procedural rules, privilege, protective orders, disclosure duties, and the governing authority.

Separate observed fact, reported fact, calculation, inference, assumption, demonstrative illustration, and opinion through explicit language and traceable citations. Every evidence object used for expert evidence and report architecture should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.43 uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[783]

Dense appendices cannot cure an unexplained reasoning chain, and polished graphics can overstate uncertain data. The test plan for expert evidence and report architecture should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.43 has weight only when the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

Disclose material uncertainty, contrary evidence, reliance on others, changes in opinion, and information withheld under authority. The report is written for the actual forum and reviewed for technical accuracy, privilege, protective orders, and disclosure duties. The final statement for expert evidence and report architecture should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty

783 MB-0645. United States Courts, Federal Rules of Evidence 702, 703, 705, and 901, Expert testimony, bases of opinion, disclosure, and authentication rules.

statement, and decision authority. Section 36.43 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[784]

Table 36-12. Expert-report architecture for a forensic acoustic matter

Report part	Required content	Quality question	Common defect
Instructions and scope	Client, decision, materials, assumptions, exclusions, information controls	Is the engagement and role transparent?	Scope expands silently after testing begins
Facts and configuration	Chronology, room states, drawings, observations, records, disputed facts	Can another reviewer reconstruct the factual basis?	Facts, hearsay, assumption, and opinion are blended
Methods and data	Methods, editions, instruments, calibration, sampling, raw-data provenance, deviations	Are methods reproducible and fit for the proposition?	Only selected plots or final averages are preserved
Analysis and alternatives	Mechanisms, predictions, calculations, uncertainty, negative evidence, sensitivity	Were plausible alternatives fairly tested?	The report announces a cause without discriminating evidence
Opinions and limitations	Each opinion, basis, confidence, valid range, unresolved issue, contrary evidence	Does the strength of language match the evidence?	Possibility is described as probability or certainty
Appendices and disclosure set	Evidence index, source register, calculations, photographs, data manifest, qualifications	Is the disclosed set complete and internally consistent?	Appendix identifiers do not match the working record

Worked example 36.57. Opinion sensitivity to disputed assumptions

Engineering question. A qualitative confidence score is 0.76. Plausible disputed assumptions change it by -0.12 to +0.08. What range should be disclosed?

784 MB-0644. United States Courts, Federal Rules of Civil Procedure 26.

Variables and assumptions. C0 is baseline confidence; delta_i are sensitivity changes; c_min and C_max bound the result.

Result and engineering significance. The disclosed range is 0.64 to 0.84; the opinion remains positive but its strength is fact-dependent.

Limitation. The score is an explanatory device, not a statistical probability or legal standard.

36.44 Litigation testing, independent review, and reproducibility

The analytical burden is exacting. Litigation testing requires reproducibility without allowing the adversarial setting to dictate an unscientific method. Protocols should define notice, access, instrumentation, calibration, source and receiver states, data exchange, preservation, observers, deviations, and opportunities for independent analysis. A jointly witnessed test can still be methodologically defective, while minor procedural disagreement does not necessarily invalidate sound evidence.

Work under Section 36.44 may later be examined by counsel, an owner, an authority, an insurer, a tribunal, or an independent reviewer. The record for litigation testing, independent review, and reproducibility must consequently distinguish observation, calculation, inference, assumption, and opinion without disguising uncertainty. For Section 36.44, this technical treatment is not legal advice; the actual matter requires separate determination of procedural rules, privilege, protective orders, disclosure duties, and the governing authority.

Use a written protocol, witness list, agreed coordinates where possible, duplicate records, calibration evidence, and preserved raw data. Every evidence object used for litigation testing, independent review, and reproducibility should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.44 uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[785]

A demonstration designed only to persuade can differ from a test designed to measure, and an unrepeatable intervention can prevent independent evaluation. The test plan for litigation testing, independent review, and reproducibility should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.44 has weight only when the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

Where full replication is impossible, preserve enough detail for analytical reproduction and identify scene changes. Independent review tests the chain of reasoning and does not merely endorse the conclusion. The final statement for litigation testing, independent review, and reproducibility should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.44 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[786]

785 MB-0646. ISO and IEC, ISO/IEC 17025:2017.
786 MB-0647. United States Courts, Federal Rules of Civil Procedure 26.

Worked example 36.58. Interlaboratory compatibility screen

Engineering question. What En number compares a laboratory result of 51.2 dB with reference 52.0 dB when expanded uncertainties are 1.8 and 1.2 dB?

Variables and assumptions. x_lab and x_ref are results; u_lab and U_ref are expanded uncertainties; e_n is normalised error.

Result and engineering significance. The absolute En value is 0.370, below one under the illustrative compatibility screen.

Limitation. Comparable measurands, methods, states, and coverage factors are prerequisites.

36.45 Security-incident classification and threat-neutral language

This inquiry should be treated as a coupled physical and evidentiary problem. Security-incident classification should describe observed consequence and evidentiary confidence without prematurely attributing hostile action. Terms such as anomaly, vulnerability, exposure, suspected compromise, and confirmed compromise should be defined and linked to authority, access, information consequence, and corroboration. Threat-neutral language preserves investigative options and reduces the risk that conjecture becomes institutional fact.

Use controlled terms, preserve security markings, coordinate incident categorisation with the responsible authority, and record the basis for any protective action. Every evidence object used for security-incident classification and threat-neutral language should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.45

uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[787]

Sensational language can contaminate witness accounts, expand dissemination, and exceed the available evidence. The test plan for security-incident classification and threat-neutral language should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.45 has weight only when the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

Report source, path, receiver, listener access, time, state, and confirmed information consequence separately. Final incident classification and notification remain authority functions informed, but not replaced, by engineering evidence. The authority vocabulary should remain jurisdiction-specific, following the comparative controls in Chapter 32. The final statement for security-incident classification and threat-neutral language should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.45 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[788]

787 MB-0649. International Organization for Standardization, ISO 31000:2018.
788 MB-0648. ASTM International, ASTM E2713-25.

Worked example 36.59. Threat-neutral incident severity screen

Engineering question. What multiplicative planning index follows from audibility 0.7, intelligibility 0.5, access 0.8, duration 0.6, and information sensitivity 0.9?

Variables and assumptions. A, I, X, T, and S are bounded planning factors; q is a severity-screen index.

Result and engineering significance. The planning index is 0.151 and can support triage across cases using the same scale.

Limitation. The index is not proof of compromise and does not replace authority-led incident classification.

36.46 Programme-level population review and common-cause analysis

A defensible examination begins from a bounded proposition. Programme-level review asks whether a local failure is an isolated defect or evidence of a common process condition across a population of rooms. Sampling, installer and product histories, detail families, maintenance patterns, complaint clusters, configuration records, and hierarchical or stratified analysis can identify common-cause risk. Population inference must respect dependence and selection bias; a dramatic case is not automatically representative.

Section 36.46 treats secure-room performance as a maintained configuration rather than a one-time result. Within Section 36.46, wear, adjustment, cleaning, software updates, filter changes, tenant work, and emergency repairs can move the system away from the accepted state. For programme-level population review and common-cause analysis, lifecycle control becomes effective only when triggers, ownership, response times, records, and the consequences of missed action are explicit.

Define the affected population, stratify by causal attributes, screen records, inspect a defensible sample, and escalate according to findings. Every evidence object used for programme-level population review and common-cause analysis should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.46 uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[789]

Convenience sampling of nearby rooms can miss a distributed defect or exaggerate a local problem. The test plan for programme-level population review and common-cause analysis should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.46 has weight only when the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

Use risk-based population review, statistical detection logic, and consistent evidence grading. Programme closure records rooms screened, findings, exclusions, corrective action, and the basis for residual population risk. The final statement for programme-level population review and common-cause analysis should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision

789 MB-0651. International Organization for Standardization, ISO 9001:2015.

authority. Section 36.46 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[790]

Table 36-13. Programme-level common-cause investigation fields

Population dimension	Stratification field	Potential common cause	Required action
Design family	Room type, drawing revision, assembly detail, consultant	Repeated analytical or coordination error	Review design population and affected interfaces
Installer and supervision	Contractor, crew, shift, supervisor, location	Workmanship practice or inspection gap	Targeted sampling, training, and effectiveness review
Material and equipment lot	Manufacturer, model, batch, date, supplier	Product variation, counterfeit, substitution, or incompatibility	Quarantine, traceability review, laboratory or field comparison
Operating system	Controls version, schedule, plant mode, masking firmware	Common configuration or software defect	Fleet configuration audit and controlled update
Maintenance regime	Provider, procedure, interval, parts, work order	Systematic wear, adjustment, or restoration failure	Revise procedure, inspect population, and monitor recurrence

Worked example 36.60. Common-cause population detection

Engineering question. If a common detail defect affects 8% of rooms, what is the probability of observing at least one in a sample of 25 approximately independent rooms?

Variables and assumptions. p is affected-room prevalence; n is sampled rooms; p is detection probability.

Result and engineering significance. The detection probability is 87.6%. Stratification remains necessary when rooms share crews, designs, or material lots.

Limitation. The model assumes independent rooms and known prevalence.

790 MB-0650. International Organization for Standardization, ISO 31000:2018.

36.47 Lessons learned, corrective action, and effectiveness review

The decisive distinction is between observation and causal proof. Lessons learned become effective only when they alter requirements, designs, training, surveillance, maintenance, or decision processes and are later tested for efficacy. Corrective actions should carry owners, deadlines, evidence of implementation, effectiveness measures, and conditions for wider application. Closing an action because a document was issued is not evidence that the causal process changed.

Section 36.47 treats secure-room performance as a maintained configuration rather than a one-time result. Within Section 36.47, wear, adjustment, cleaning, software updates, filter changes, tenant work, and emergency repairs can move the system away from the accepted state. For lessons learned, corrective action, and effectiveness review, lifecycle control becomes effective only when triggers, ownership, response times, records, and the consequences of missed action are explicit.

Define the root or contributing cause, action owner, due date, implementation evidence, effectiveness metric, review interval, and criteria for reopening. Every evidence object used for lessons learned, corrective action, and effectiveness review should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.47 uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[791]

791 MB-0653. International Organization for Standardization, ISO 19011:2018.

Closing an action because a document was issued does not demonstrate that field behaviour changed. The test plan for lessons learned, corrective action, and effectiveness review should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.47 has weight only when the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

Measure leading and lagging indicators, audit representative work, and test whether recurrence or detection time improved. Lessons are distributed at the appropriate information level without exposing sensitive facility details. The final statement for lessons learned, corrective action, and effectiveness review should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.47 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[792]

Worked example 36.61. Corrective-action effectiveness

Engineering question. How much did the defect rate change from 17 findings in 240 opportunities to four findings in 260 opportunities?

Variables and assumptions. r_b and r_a are before and after rates; e is proportional reduction.

Result and engineering significance. The observed rate reduction is 78.3%.

Limitation. Opportunity definitions, inspection sensitivity, and population mix must remain comparable.

792 MB-0652. ASHRAE Standard 230-2022.

36.48 Publication, public-source, and controlled-information boundary

Engineering judgement must remain traceable. Publication and public-source discipline require technical depth without reconstructing controlled criteria or disclosing facility-specific vulnerabilities. The text may explain physics, methods, evidence classes, disclosed institutional roles, and bounded case abstractions while marking the point at which competent-authority direction is indispensable. Plausible inference cannot be used to fill a deliberate public-source gap.

Work under Section 36.48 may later be examined by counsel, an owner, an authority, an insurer, a tribunal, or an independent reviewer. The record for publication, public-source, and controlled-information boundary must consequently distinguish observation, calculation, inference, assumption, and opinion without disguising uncertainty. For Section 36.48, this technical treatment is not legal advice; the actual matter requires separate determination of procedural rules, privilege, protective orders, disclosure duties, and the governing authority.

Classify source material, record permissions, separate public and restricted appendices, generalise case details, and conduct security and legal review. Every evidence object used for publication, public-source, and controlled-information boundary should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.48 uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[793]

793 MB-0654. ASTM International, ASTM E3176-24.

Redaction that removes names but retains a unique configuration, date, and failure path may still identify the facility. The test plan for publication, public-source, and controlled-information boundary should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.48 has weight only when the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

Apply aggregation review and test whether the remaining narrative permits harmful reconstruction. The public version states its source and authority limits and does not represent itself as an accreditation manual. The final statement for publication, public-source, and controlled-information boundary should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.48 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[794]

Worked example 36.62. Redaction residual-identification screen

Engineering question. Two of ten quasi-identifiers remain in a proposed public case narrative. What simple residual fraction should trigger aggregation review?

Variables and assumptions. N_r is retained quasi-identifiers; n_t is screened identifiers; f is residual fraction.

Result and engineering significance. The residual fraction is 0.20; the combination of retained details must be tested for re-identification risk.

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794 MB-0655. United States Courts, Federal Rules of Evidence 702, 703, 705, and 901, Expert testimony, bases of opinion, disclosure, and authentication rules.

Limitation. The metric is a checklist aid, not a disclosure-law or security-authority decision.

36.49 Open issues, deferred work, and controlled release of the scene

Open issues and deferred work should be controlled as explicit technical conditions rather than allowed to disappear into narrative caveats. Each item should identify the unresolved proposition, consequence, interim control, owner, due date, access requirement, evidence needed, and event that permits scene release or re-entry. Release of the physical scene does not extinguish the obligation to preserve records, samples, and the ability to reopen analysis.

Section 36.49 treats secure-room performance as a maintained configuration rather than a one-time result. Within Section 36.49, wear, adjustment, cleaning, software updates, filter changes, tenant work, and emergency repairs can move the system away from the accepted state. For open issues, deferred work, and controlled release of the scene, lifecycle control becomes effective only when triggers, ownership, response times, records, and the consequences of missed action are explicit.

Record the issue, consequence, reason for deferral, interim control, owner, evidence needed, trigger, deadline, and authority disposition. Every evidence object used for open issues, deferred work, and controlled release of the scene should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.49 uses measurement files, the retained record should include raw channels, analysis settings, calibration,

environmental observations, processing history, and the exact operating state rather than only a selected plot.[795]

A vague statement that further work may be required is not a control and cannot support later accountability. The test plan for open issues, deferred work, and controlled release of the scene should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.49 has weight only when the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

Release only those scene areas and systems whose evidentiary value has been preserved or knowingly relinquished. The final open-issue register remains linked to room use restrictions, change control, and recommissioning. The final statement for open issues, deferred work, and controlled release of the scene should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.49 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[796]

Worked example 36.63. Open-issue priority

Engineering question. What planning priority follows from consequence 8, urgency 0.7, evidence-gap factor 0.6, and interim-control effectiveness 0.5?

Variables and assumptions. C is consequence; u is urgency; g is evidence-gap factor; e is control effectiveness; p is priority.

795 MB-0656. ASHRAE Standard 230-2022.
796 MB-0657. NIST SP 800-86.

Result and engineering significance. The bounded priority is 4.48, supporting an early revisit under the adopted portfolio scale.

Limitation. The scale is ordinal and should not be compared with a different programme without calibration.

36.50 Final forensic synthesis and lifecycle proposition

A defensible conclusion states what changed, why the explanation is preferred, what the repair demonstrated, which conditions remain unverified, and what event requires renewed examination. The final forensic synthesis should connect mechanism, evidence, intervention, uncertainty, residual risk, authority, and future configuration control in one bounded proposition. The enduring control is not a single test result but an evidence system capable of detecting when the accepted state no longer exists.

Section 36.50 treats secure-room performance as a maintained configuration rather than a one-time result. Within Section 36.50, wear, adjustment, cleaning, software updates, filter changes, tenant work, and emergency repairs can move the system away from the accepted state. For final forensic synthesis and lifecycle proposition, lifecycle control becomes effective only when triggers, ownership, response times, records, and the consequences of missed action are explicit.

Use an evidence map, path model, configuration baseline, decision record, source register, maintenance plan, and recommissioning schedule as a single controlled dossier. Every evidence object used for final forensic synthesis and lifecycle proposition should receive a stable identifier, acquisition time, responsible person, and relationship to the as-designed, as-built, as-accepted, and as-operated configurations. Where Section 36.50

uses measurement files, the retained record should include raw channels, analysis settings, calibration, environmental observations, processing history, and the exact operating state rather than only a selected plot.[797]

A passing test does not erase untested states, active dependencies, information-handling limits, or the possibility of later change. The test plan for final forensic synthesis and lifecycle proposition should name at least one alternative explanation and record the observation expected under each competing model. Negative evidence in Section 36.50 has weight only when the method possessed enough access, bandwidth, dynamic range, spatial coverage, and state control to reveal the predicted effect.

State the four propositions separately: laboratory assembly performance, installed field performance, occupied speech-security performance, and formal approval or authority to use. The room remains defensible only while its configuration, operation, evidence, and institutional authority remain aligned. The final statement for final forensic synthesis and lifecycle proposition should be bounded to the tested room, configuration, period, methods, source and receiver states, uncertainty statement, and decision authority. Section 36.50 should also identify the observation, change, or elapsed condition that would require the finding to be reopened.[798]

Worked example 36.64. Risk-adjusted recommissioning interval

Engineering question. A nominal recommissioning interval is 24 months. Wear and change factors are 0.35 and 0.25, while reliable monitoring is scored 0.8. What illustrative adjusted interval results?

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797 MB-0660. ASHRAE Standard 230-2022.
798 MB-0661. Office of the Director of National Intelligence, Technical Specifications for Construction and Management of Sensitive Compartmented Information Facilities, Version 1.5.1, Public SCIF technical specifications.

Variables and assumptions. T0 is nominal interval; w and C are wear and change factors; m is monitoring effectiveness; t is adjusted interval.

Result and engineering significance. The illustrative adjusted interval is 9.0 months, subject to event-driven triggers.

Limitation. The formula is a transparent planning model, not a consensus-standard interval.

Chapter 36 Glossary

The glossary defines terms as they are used in this chapter. A definition does not enlarge the scope of a cited standard, authorise a secure facility, or resolve a jurisdiction-specific legal meaning.

Alternative hypothesis. A credible explanation for the observed condition that must be tested rather than dismissed by preference.

As-operated state. The physical, mechanical, electronic, and operational condition existing during use or examination.

Baseline reconstruction. Recreation of the relevant historical and present configuration from requirements, records, observations, and measurements.

Bounded conclusion. A conclusion limited to the stated object, method, state, evidence, and authority.

Causal mechanism. A physical, operational, or management process capable of producing the observed condition.

Coherence. A frequency-dependent measure of linear association between measured signals under a stated estimation method.

Configuration uncertainty. Incomplete knowledge about the actual physical or operating state.

Controlled intervention. A reversible or authorised change intended to discriminate among hypotheses while collateral variables are monitored.

Controlled opening. Authorised destructive or intrusive access to concealed construction for direct observation and sampling.

Decision rule. A stated method for comparing a result and its uncertainty with a requirement or acceptance boundary.

Dominant-path migration. Change in the path controlling total performance after another path is reduced.

Dynamic range. The range over which the method can distinguish the source contribution from background and instrument limitations.

Evidence custody. Documented identity, transfer, storage, access, and processing of files, photographs, samples, and other records.

Evidence map. A structured link among proposition, observation, source, method, record identifier, and conclusion.

Forensic acoustic engineering. Application of acoustic, vibration, building-science, metrology, and evidentiary methods to a defined event, condition, claim, or failure.

Guard band. An interval applied between a measured result and a decision boundary to manage conformity risk under uncertainty.

Hypothesis prediction. An observation expected if a proposed mechanism is material, paired with an observation expected to weaken it.

Intervention contrast. The difference between controlled states used to assess the consequence of a deliberately changed variable.

Localisation. Narrowing a system-level consequence to a path family, region, component, or concealed condition.

Model discrepancy. Difference between the selected representation and the behaviour of the real room or system.

Negative evidence. A relevant expected observation that was not found under conditions capable of revealing it.

Operating-state matrix. A controlled list of source, boundary, plant, background, access, and equipment states to be reproduced during testing.

Path budget. A quantitative or bounded account of parallel transmission contributions to complete-envelope performance.

Provenance. The documented origin, custody, transformation, and relationship of an item of evidence.

Recommissioning. Verification after repair, change, or elapsed time that the accepted configuration and required performance remain supported.

Residual risk. Risk remaining after treatment, including unverified conditions, active dependencies, and future change mechanisms.

Scene release. Authorised return of a room, system, or area to use after evidentiary needs and restoration conditions have been addressed.

Source-state matrix. A record of credible talker, loudspeaker, equipment, plant, masking, and background states relevant to the proposition.

Spatial correlation. Dependence among observations taken at nearby positions, which reduces the effective independent sample size.

Technical closure. Completion of the evidence, repair, verification, limitation, and record chain needed for a bounded engineering disposition.

Traceability. Property of a result whereby it can be related to references through a documented calibration chain with stated uncertainties.

Value of information. Expected benefit of an observation in changing a decision, relative to its cost, disruption, risk, and ambiguity.

Chapter 36 Source and Public-Access Limitations Register

The following register records the public and lawfully accessible sources frozen on 2026-08-16. Proprietary standards are identified by title and public catalogue metadata; their normative text is not reproduced. Public acknowledgement of controlled governmental material is not used to infer protected thresholds, inspection methods, or approval criteria.[799][800]

Table 36-14. Source and public-access limitations register

Key	Issuer and identifier	Title	Status at source freeze	Technical role and limitation	Cited sections
FEN1	ASTM International; ASTM E2713-25	Standard Guide to Forensic Engineering	Active; last updated 10 February 2025	Forensic-engineering scope, professional roles, and bounded investigative practice Limitation: Informational guide. It does not prescribe acoustic acceptance criteria or confer professional licensure.	36.1, 36.2, 36.3, 36.8, 36.25, 36.30, 36.31, 36.44, 36.45, 36.50

799 MB-0661. Office of the Director of National Intelligence, Technical Specifications for Construction and Management of Sensitive Compartmented Information Facilities, Version 1.5.1, Public SCIF technical specifications.
800 MB-0662. United States Courts, Federal Rules of Evidence 702, 703, 705, and 901, Expert testimony, bases of opinion, disclosure, and authentication rules.

Key	Issuer and identifier	Title	Status at source freeze	Technical role and limitation	Cited sections
FEN2	ASTM International; ASTM E3176-24	Standard Guide for Forensic Engineering Expert Reports	Active; last updated 25 March 2024	Forensic report purpose, content, limitations, and electronic representation Limitation: Informational guide. Report form remains subject to engagement terms, applicable law, and tribunal orders.	36.1, 36.4, 36.30, 36.42, 36.43, 36.48
AC01	ASTM International; ASTM E336-25a	Standard Test Method for Measurement of Airborne Sound Attenuation between Rooms in Buildings	Active at source freeze	Field room-to-room airborne sound-attenuation measurement Limitation: A field result is configuration and state specific. It does not alone establish speech-security approval.	36.6, 36.9, 36.10, 36.17, 36.28, 36.29, 36.35, 36.40

Key	Issuer and identifier	Title	Status at source freeze	Technical role and limitation	Cited sections
AC02	International Organization for Standardization; ISO 16283-1:2014 with Amendment 1:2017	Acoustics - Field measurement of sound insulation in buildings and of building elements - Part 1: Airborne sound insulation	Confirmed current in 2025	International field measurement procedures for airborne sound insulation Limitation: Proprietary standard. Applicability, frequency range, room volume, and acceptance criteria require project-specific adoption.	36.6, 36.9
AC03	International Organization for Standardization; ISO 12999-1:2020	Acoustics - Determination and application of measurement uncertainties in building acoustics - Part 1: Sound insulation	Confirmed in September 2025	Building-acoustic uncertainty treatment Limitation: Does not supply a universal secure-room decision threshold.	36.9, 36.29, 36.32, 36.40
MET01	Joint Committee for Guides in Metrology; JCGM 100:2008	Evaluation of measurement data - Guide to the expression of uncertainty in measurement	Public metrology guide at source freeze	Measurement models, standard uncertainty, covariance, and expanded uncertainty Limitation: General metrology guidance. The measurand and decision rule remain application specific.	36.1, 36.22, 36.28, 36.32, 36.35

Key	Issuer and identifier	Title	Status at source freeze	Technical role and limitation	Cited sections
MET02	Joint Committee for Guides in Metrology; JCGM 106:2012	Evaluation of measurement data - The role of measurement uncertainty in conformity assessment	Public metrology guide at source freeze	Conformity decisions, acceptance limits, and risks of false acceptance or rejection Limitation: Does not select the underlying acoustic or security requirement.	36.29, 36.32, 36.39, 36.40
LAB01	ISO and IEC; ISO/IEC 17025:2017	General requirements for the competence of testing and calibration laboratories	Current at source freeze	Laboratory competence, impartiality, traceability, technical records, and validity of results Limitation: Accreditation scope must include the actual method. Laboratory accreditation does not confer facility authorisation.	36.22, 36.27, 36.44
LAB02	International Electrotechnical Commission; IEC 61672-1:2013	Electroacoustics - Sound level meters - Part 1: Specifications	Edition cited at source freeze	Performance requirements for sound level meters Limitation: Instrument class does not cure an unsuitable method, geometry, or state definition.	36.11, 36.27

Key	Issuer and identifier	Title	Status at source freeze	Technical role and limitation	Cited sections
LAB03	International Electrotechnical Commission; IEC 60942:2017	Electroacoustics - Sound calibrators	Edition 4.0 at source freeze	Performance requirements for acoustic calibrators Limitation: A field check at one frequency does not establish complete frequency response, phase match, or channel linearity.	36.27
LAB04	International Organization for Standardization; ISO 5348:2021	Mechanical vibration and shock - Mechanical mounting of accelerometers	Published edition at source freeze	Accelerometer mounting and associated measurement limitations Limitation: Mounting guidance does not identify the source or causal path without a suitable test design.	36.21
AIR01	ASTM International; ASTM E90-23	Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements	Active at source freeze	Laboratory specimen transmission loss Limitation: Results apply to the tested specimen and mounting. Field equivalence requires separate evidence.	36.12, 36.15

Key	Issuer and identifier	Title	Status at source freeze	Technical role and limitation	Cited sections
AIR02	International Organization for Standardization; ISO 10140-2:2021	Acoustics - Laboratory measurement of sound insulation of building elements - Part 2: Measurement of airborne sound insulation	Published edition at source freeze	International laboratory airborne sound-insulation measurement Limitation: A laboratory element rating is not a whole-room or authorisation result.	36.12
SP01	ASTM International; ASTM E2638-24	Standard Test Method for Objective Measurement of the Speech Privacy Provided by a Closed Room	Active at source freeze	Closed-room speech-privacy measurement framework Limitation: The method does not set universal acceptance criteria and does not address electronic interception.	36.2, 36.20
SP02	International Electrotechnical Commission; IEC 60268-16:2020 with Corrigendum 1:2025	Sound system equipment - Part 16: Objective rating of speech intelligibility by speech transmission index	Edition 5.0; corrected July 2025	Speech Transmission Index methods and limitations Limitation: STI depends on source, noise, processing, language, and listener assumptions. It is not a universal secure-room criterion.	36.19, 36.20

Key	Issuer and identifier	Title	Status at source freeze	Technical role and limitation	Cited sections
SP03	Acoustical Society of America; ANSI/ASA S3.5-1997 (R2022)	Methods for Calculation of the Speech Intelligibility Index	Reaffirmed edition cited at source freeze	Speech Intelligibility Index calculation framework Limitation: Does not replace field isolation evidence or competent-authority criteria.	Register only
DOOR1	ASTM International; ASTM E2964-26	Standard Test Method for Measurement of the Normalized Insertion Loss of Doors	Active at source freeze	Low-frequency and component-level field assessment of doors Limitation: Door evidence is configuration specific and does not establish complete-envelope performance.	36.14
SEAL1	ASTM International; ASTM C919-24	Standard Practice for Use of Sealants in Acoustical Applications	Active at source freeze	Acoustical sealant application practice Limitation: Sealant practice does not establish fire, movement, durability, or whole-room performance by itself.	36.13, 36.14

Key	Issuer and identifier	Title	Status at source freeze	Technical role and limitation	Cited sections
VIB1	International Organization for Standardization; ISO 20816-1:2016	Mechanical vibration - Measurement and evaluation of machine vibration - Part 1: General guidelines	Published edition at source freeze	General vibration measurement and evaluation concepts Limitation: Machine-vibration severity guidance is not a building-acoustic causal criterion.	36.18, 36.21
VIB2	International Organization for Standardization; ISO 7626 series	Mechanical vibration and shock - Experimental determination of mechanical mobility	Series cited at source freeze	Mobility and transfer-function measurement concepts Limitation: Results depend on excitation, support, sensor mounting, linearity, and boundary conditions.	36.11, 36.15
FLANK1	ASTM International; ASTM E1414/E1414M-21a	Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum	Active edition cited at source freeze	Ceiling-plenum transmission assessment Limitation: Method scope does not isolate all structural, duct, wall, and service contributions.	36.16

Key	Issuer and identifier	Title	Status at source freeze	Technical role and limitation	Cited sections
FLANK2	International Organization for Standardization; ISO 10848-1:2017	Acoustics - Laboratory and field measurement of flanking transmission - Part 1: Frame document	Published and current at source freeze	Flanking-transmission framework and quantities Limitation: Selection of the supporting part and interpretation depend on element and junction type.	36.16
HVAC1	ASTM International; ASTM E477-26	Standard Test Method for Laboratory Measurements of Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers	Active at source freeze	Laboratory silencer insertion loss, airflow, and regenerated-noise evidence Limitation: Laboratory data do not prove installed-network performance under every airflow and connection state.	36.17
HVAC2	ASHRAE; 2023 ASHRAE Handbook - HVAC Applications	Sound and vibration control and related applications chapters	Current handbook volume at source freeze	HVAC sound, vibration, system effects, and engineering practice Limitation: Handbook guidance requires project-specific design, measurement, and authority review.	36.17

Key	Issuer and identifier	Title	Status at source freeze	Technical role and limitation	Cited sections
FIRE1	ASTM International; ASTM E814-24	Standard Test Method for Fire Tests of Penetration Firestop Systems	Active page accessed at source freeze; later work item under development	Fire resistance testing of penetration firestop systems Limitation: Fire-resistance evidence and acoustic closure are separate propositions. Direct catalogue confirmation is required before project application.	36.14, 36.18
FIRE2	ASTM International; ASTM E2174-24	Standard Practice for On-Site Inspection of Installed Firestop Systems	Edition cited at source freeze	Installed firestop inspection practice Limitation: Inspection to this practice does not establish acoustic performance unless that proposition is separately tested.	36.18, 36.37
LEAK1	ASTM International; ASTM E1186-22	Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems	Active at source freeze	Qualitative air-leakage site detection methods Limitation: Air leakage and acoustic leakage can correlate, but neither is a universal surrogate for the other.	36.13, 36.23, 36.24

Key	Issuer and identifier	Title	Status at source freeze	Technical role and limitation	Cited sections
LEAK2	ASTM International; ASTM E779-19	Standard Test Method for Determining Air Leakage Rate by Fan Pressurization	Active edition cited; revision work item exists	Whole-building or zone air-leakage rate by pressurisation Limitation: The method does not locate every path and does not directly yield acoustic transmission loss.	36.23
THERM1	International Organization for Standardization; ISO 6781-1:2023	Performance of buildings - Detection of heat, air and moisture irregularities in buildings by infrared methods - Part 1: General procedures	Published edition at source freeze	Infrared examination of building-envelope irregularities Limitation: Thermal contrast is indirect evidence and is sensitive to boundary conditions, emissivity, moisture, and time.	36.24
THERM2	International Organization for Standardization; ISO 18436-7:2014	Condition monitoring and diagnostics of machines - Requirements for qualification and assessment of personnel - Part 7: Thermography	Confirmed in 2025	Thermography personnel competence framework Limitation: Personnel qualification does not convert a thermal anomaly into proof of an acoustic mechanism.	36.24

Key	Issuer and identifier	Title	Status at source freeze	Technical role and limitation	Cited sections
DIG1	National Institute of Standards and Technology; NIST SP 800-86	Guide to Integrating Forensic Techniques into Incident Response	Public NIST publication at source freeze	Digital evidence acquisition, examination, analysis, and reporting concepts Limitation: Cyber incident-response guidance requires adaptation to building systems, legal process, and information controls.	36.3, 36.19, 36.26, 36.49
DIG2	National Institute of Standards and Technology; FIPS PUB 180-4	Secure Hash Standard	Current publication with revision announced	Approved secure hash algorithms for integrity manifests Limitation: A matching hash supports bit-level integrity, not truth, completeness, or causal meaning.	36.3, 36.26, 36.41

Key	Issuer and identifier	Title	Status at source freeze	Technical role and limitation	Cited sections
COMM1	ASHRAE; ASHRAE Guideline 0-2019	The Commissioning Process	Published guideline at source freeze	Commissioning roles, documentation, verification, and issue resolution Limitation: Project-specific secure-room requirements and competent-authority decisions remain controlling.	36.5, 36.41
COMM2	ASHRAE and IES; ANSI/ASHRAE/IES Standard 202-2024	Commissioning Process Requirements for New Buildings and New Systems	Published standard at source freeze	Minimum commissioning-process requirements Limitation: Does not provide acoustic security thresholds or replace specialist tests.	36.6
COMM3	ASHRAE; ASHRAE Standard 230-2022	Commissioning Process for Existing Buildings and Systems	Published standard at source freeze	Existing-building commissioning and ongoing performance verification Limitation: Existing-building application requires a defined scope, baseline, and authority.	36.7, 36.20, 36.33, 36.36, 36.38, 36.39, 36.47, 36.49, 36.50

Key	Issuer and identifier	Title	Status at source freeze	Technical role and limitation	Cited sections
QUAL1	International Organization for Standardization; ISO 9001:2015 with Amendment 1:2024	Quality management systems - Requirements	Published edition and amendment at source freeze	Quality-system control of processes, records, nonconformity, and corrective action Limitation: Certification does not establish technical adequacy of a particular repair or test.	36.7, 36.36, 36.38, 36.46, 36.47
QUAL2	International Organization for Standardization; ISO 10005:2018	Quality management - Guidelines for quality plans	Published edition at source freeze	Project-specific quality planning and responsibilities Limitation: Guidance must be translated into technical hold points and acceptance evidence.	36.5, 36.34, 36.37
QUAL3	International Organization for Standardization; ISO 19011:2018	Guidelines for auditing management systems	Published edition at source freeze	Audit principles, evidence, sampling, and competence Limitation: Management-system auditing is not a substitute for physical measurement or destructive verification.	36.47

Key	Issuer and identifier	Title	Status at source freeze	Technical role and limitation	Cited sections
CONST1	United States Department of Defense; UFGS 01 45 00	Quality Control	Public UFGS edition and changes at source freeze	Preparatory, initial, follow-up, testing, and documentation controls for construction quality Limitation: Project specifications and secure-room authority requirements remain controlling.	36.5, 36.7, 36.25, 36.34, 36.37
GOV1	Office of the Director of National Intelligence; Technical Specifications for Construction and Management of Sensitive Compartmented Information Facilities, Version 1.5.1	Public SCIF technical specifications	Public version at source freeze	Public facility-governance, construction, inspection, and lifecycle context Limitation: Controlled supplements, classified criteria, project-specific vulnerabilities, and authority decisions are excluded.	36.19, 36.33, 36.38, 36.41, 36.45, 36.48, 36.50

Key	Issuer and identifier	Title	Status at source freeze	Technical role and limitation	Cited sections
LEGAL1	United States Courts; Federal Rules of Evidence 702, 703, 705, and 901	Expert testimony, bases of opinion, disclosure, and authentication rules	Rule 702 amendment effective 1 December 2023; current rules must be checked for the forum	General United States federal evidentiary framework Limitation: Not legal advice. State, foreign, arbitral, administrative, and protective-order requirements may differ.	36.4, 36.26, 36.42, 36.43, 36.48, 36.50
LEGAL2	United States Courts; Federal Rules of Civil Procedure 26(a)(2), 34, and 37(e)	Expert disclosures, production, and preservation of electronically stored information	Current federal rules must be checked for the forum	General federal civil-discovery and expert-disclosure framework Limitation: Not legal advice. Engagement terms, court orders, privilege, work product, and local rules control.	36.4, 36.42, 36.43, 36.44
RISK1	International Organization for Standardization; ISO 31000:2018	Risk management - Guidelines	Published edition at source freeze	Risk framing, analysis, evaluation, treatment, monitoring, and communication Limitation: Does not supply secure-room likelihoods, consequences, or acceptance criteria.	36.2, 36.8, 36.30, 36.31, 36.33, 36.36, 36.45, 36.46, 36.49

Key	Issuer and identifier	Title	Status at source freeze	Technical role and limitation	Cited sections
STAT1	National Institute of Standards and Technology; NIST/SEMATECH e-Handbook of Statistical Methods	Engineering statistics reference	Public NIST resource at source freeze	Experimental design, sampling, estimation, control charts, and statistical diagnostics Limitation: Statistical methods require a physically valid model and representative data.	36.8, 36.10, 36.25, 36.28, 36.31, 36.39, 36.46
BOOK1	Carl Hopkins; Sound Insulation, 2007	Sound Insulation	Recognised engineering monograph	Building sound-insulation theory, field and laboratory quantities, and flanking Limitation: Textbook analysis must be reconciled with current standards and the actual construction.	36.10, 36.12, 36.15, 36.16, 36.35
BOOK2	Frank Fahy and Paolo Gardonio; Sound and Structural Vibration, 2nd ed., 2007	Sound and Structural Vibration	Recognised engineering monograph	Structural waves, mobility, power flow, radiation, and vibration measurement Limitation: Idealised models require configuration-specific validation.	36.21

Key	Issuer and identifier	Title	Status at source freeze	Technical role and limitation	Cited sections
BOOK3	David A. Bies, Colin H. Hansen, and Carl Q. Howard; Engineering Noise Control, 6th ed., 2024	Engineering Noise Control: Theory and Practice	Current recognised engineering monograph at source freeze	Noise-control physics, sources, propagation, measurement, and diagnostic practice Limitation: General engineering treatment does not replace project-specific testing or authority decisions.	36.11, 36.13, 36.22, 36.23, 36.34

Source status must be rechecked before project use. Public metadata does not determine which contract, competent authority, accreditation scope, protective order, or later revision governs the engagement.