

Hardware product readiness

A practical guide + six review checklists

Turn an idea into a build you can explain, reproduce, and improve. Use this guide to decide what is ready, what needs evidence, and what the next useful step should be.



A little discipline. More room to make.

01 Find trouble earlier

Expose missing requirements, awkward assembly, weak sourcing, and test gaps while changes are still manageable.

02 Make work repeatable

Give the next builder the right revisions, instructions, and acceptance checks. Reduce dependence on memory.

03 Decide with confidence

Tie the next build or release to visible evidence, named owners, and clear conditions. Keep the learning moving.

START HERE

Pages 02-06: choose a review, learn the terms, and see how to use the evidence.

Pages 07-12: print the six worksheets and record the next build decision.

Companion to the Green Shoe Garage Agile + Systems Engineering Vee, v2.0.

Find your place in the build.

Use a review when a decision is coming up. Revisit it when the design, process, supplier, or evidence changes.

SIX CONVERSATIONS WORTH HAVING

01	Design Is the problem clear, and is the design worth building?	07
02	Build package Can someone build the intended version reliably?	08
03	Suppliers + tooling Are the parts, people, processes, and equipment ready?	09
04	Test Do we know what to prove, how, and on which version?	10
05	Production Can we repeat the build at the proposed cost and rate?	11
06	Delivery + support Can people use, maintain, repair, and retire it?	12

SCALE IT TO THE JOB

One-off / workshop project

Keep evidence light: a sketch, parts list, photos, measurements, and a short record of what changed.

Prototype / pilot build

Review the uncertainty you are trying to reduce. Record which assumptions and configurations the build will test.

Repeat builds / product release

Use controlled instructions, traceability, acceptance checks, and explicit build or shipment authorization.

HOW AGILE FITS THE VEE

The **Vee** connects needs and design decisions to the evidence that checks them. Work breaks down into parts, then integrates into a useful whole. These reviews can overlap and repeat; they are not isolated phases.

Agile work starts during discovery. A **backlog** is the ordered work list; a **sprint** is a short planning interval. An experiment, model, fixture, test result, or repair can be an increment. **Done** means reviewed output, evidence, recorded configuration, updated notes, and disposition of open issues.

Run a useful readiness review.

Use one sheet for a defined scope. The evidence can live in a notebook, shared folder, repository, or product system.

FROM QUESTION TO DECISION

- 1 Name the build.**
Record the project, exact configuration, purpose, quantity, and date. Decide what this review is authorizing.
- 2 Bring the evidence.**
Use drawings, analyses, measurements, photos, test records, supplier data, or reviewed demonstrations. Record a usable reference.
- 3 Review with the right people.**
Assign one decision owner and item owners. On a small project, one person may hold several roles.
- 4 Mark each item honestly.**
Compare evidence with the agreed criterion. A blank or planned task is still open; it does not mean ready.
- 5 Record the next move.**
Write the decision, unresolved issues, conditions, owners, due dates, and the trigger for the next review.

STATUS KEY

- R Ready**
Evidence meets the criterion for this scope.
- C Conditional**
The decision owner authorizes explicit remaining conditions, with owners and due dates.
- H Hold**
Do not authorize the affected build or release until the blocking issue is resolved.
- N Not applicable**
Explain why the item does not apply to this scope. Exclusion needs a reason.

A conditional decision does not waive unresolved safety or applicable compliance constraints. Completing a story does not itself authorize production or shipment.

EXAMPLE: A USEFUL EVIDENCE ENTRY

B01 - Released technical package

Evidence: release folder R03 / manifest-03 / assembly Rev C.

Owner: J. Lee. Status: C.

Condition: update the wiring photo and confirm the connector pinout before the next build. J. Lee owns it; due 16 Oct.

Why it works: the reviewer can find the version and see the remaining action.

Five words that change the test.

Example: a battery-powered workshop temperature logger. Each question needs its own evidence.

Term	The question it answers	What the evidence might look like
Verification	Did we meet the specified requirements?	Compare readings with a suitable reference at specified test points; check accuracy and battery runtime against agreed limits.
Validation	Does this solve the intended user's problem in the intended setting?	Ask representative users to set up the logger, read it, and retrieve records in the workshop. Observe task success and confusion.
Qualification	Does the design meet its specified operating envelope and margins?	Assess representative units against the planned temperature, humidity, or vibration conditions. Record the design and test setup.
Production acceptance	Does this particular unit or batch meet the approved release criteria?	Execute the approved inspection and functional checks; retain unit or batch results before release.
Compliance	Have we met the applicable obligations and standards?	Identify what applies to this product and market, then retain the required evaluations, reports, declarations, and markings.

A TEST RESULT NEEDS CONTEXT

Verification can use inspection, analysis, demonstration, or testing. Record the configuration, method, conditions, limits, and result. A pass on one prototype does not automatically cover a changed design or every production unit.

Translate the design-shop shorthand.

Keep the language useful. These are working definitions for the worksheets, not a required documentation system.

Requirements + acceptance criteria

Requirements state what the product must do or satisfy. Acceptance criteria are the observable limits or outcomes used to decide whether it passes.

Operational concept

A short description of who uses, installs, or maintains the product, what they do, and the environment it must work in.

Baseline + configuration control

A baseline is an identified, agreed version. Configuration control records it, assesses and approves changes, and retains what was built and tested.

Traceability + configuration items

Traceability links needs, requirements, design, and evidence, and identifies units or lots. HWCI / SWCI means hardware / software configuration item.

Interfaces + engineering budgets

Interfaces are the physical, electrical, data, or human connections between parts. Budgets allocate limits such as power, mass, heat, timing, and dimensions.

Trade study + risk review

A trade study compares options against criteria. Risk reviews examine hazards, failure modes, threats, consequences, and actions to reduce uncertainty or harm.

DFM / DFA / DFT

Design for manufacture / assembly / test: shape the design so it can be fabricated, put together, and checked with the intended tools and processes.

BOM + approved alternates

The bill of materials lists required parts and materials. Approved alternates are reviewed substitutes; an available part is not automatically interchangeable.

CAD / PCB / CAM

Computer-aided design / printed circuit board / computer-aided manufacturing. These files describe geometry, circuit hardware, or machine instructions.

Tolerances + critical characteristics

Tolerances are allowed variation. A stack-up checks how variations combine. Critical characteristics are features needing particular control for function, safety, or quality.

Datums + tooling

Datums are reference points, lines, or surfaces for measurements. Tooling includes molds, fixtures, jigs, and other equipment used to make, locate, or check a part.

Programming + provisioning

Programming loads software or firmware. Provisioning assigns device identity, settings, credentials, or keys. A hash is a digital fingerprint for checking file identity.

ESD + process controls

Electrostatic discharge can damage sensitive parts. Process controls specify handling, settings, checks, and records needed to keep the build consistent.

As-designed / as-built / as-tested

The intended design, what was actually made, and the configuration used for a result. Keep revisions, serials or lots, firmware, and deviations linked.

Know what ready means at the bench.

These terms turn test results and build experience into a decision about the next configuration, quantity, and rate.

Evidence matrix + regression

An evidence matrix links each requirement to a method, limit, owner, and result. Regression checks look for unintended effects after a change.

Calibration + measurement capability

Calibration establishes an instrument's relationship to a reference. Capability asks whether the whole measurement method is suitable for the tolerance or decision.

Qualification vs. first article vs. pilot

Qualification evaluates the design envelope. First-article inspection checks an initial manufactured item. A pilot build exercises the intended production process.

Yield / scrap / rework

Yield is the fraction passing the stated stage and counting rules. Scrap is unusable output. Rework is extra work needed to bring an item into conformance.

Process capability / cycle time / capacity

Capability concerns process variation against limits. Cycle time measures time per operation or unit. Capacity is the output the resources can sustain.

Nonconformance + corrective action

A nonconformance misses a requirement. Record its disposition: rework, reject, or an approved exception. Corrective action addresses the cause and checks effectiveness.

Deviation + change impact

A deviation is an approved departure for a defined scope. A change-impact review asks what requirements, interfaces, risks, and evidence need to be revisited.

Security assessment + pentesting

Assess threats, weaknesses, and protections. Penetration testing is authorized probing for exploitable weaknesses. Track fixes and a process for future vulnerability reports.

G1 / G2: AUTHORIZE THE NEXT BUILD

In this Green Shoe Garage model, **G1** authorizes a defined low-rate build. **G2** authorizes a justified increase in rate. Record the configuration, quantity or rate, owner, evidence, and conditions. Exploratory builds can begin earlier.

Low-rate units may ship once applicable qualification, compliance, and acceptance conditions are met. The diagram's 100-unit V1.0 kickstart run and three-week sprint are examples, not requirements. A review is a decision for a scope, not a blanket approval.

READ FURTHER

NASA: system design

NASA: product realization

NASA: technical management

NIST: IoT cybersecurity, IR 8259 Rev. 1

MITRE: manufacturing readiness criteria

Tailor the depth to the product, build, and risk. This guide is not a certification scheme. Edition: 13 October 2026.

Design readiness

Confirm the problem, design basis and evidence plan before committing the relevant build.

Project: _____ Build / baseline: _____ Date: _____

Decision owner: _____ Suggested role: Design lead / product owner

R ready | C conditional | H hold | N not applicable (explain why). Record evidence you can find and review.

ID	Check and expected evidence	Evidence reference	Item owner	R/C/H/N
D01	Stakeholders and operational concept User, installer and maintainer scenarios; operating environments; usability and accessibility needs.	_____	_____	☐
D02	Measurable requirements and success criteria Needs-to-requirements links, allocated capabilities, constraints, acceptance limits and design-to specifications.	_____	_____	☐
D03	Feasibility and product economics Expected quantities, price / unit-cost targets, development / tooling budgets, schedule and make-versus-buy rationale.	_____	_____	☐
D04	Architecture, alternatives and interfaces Trade studies, feasibility experiments, interface owners and power, thermal, mass, timing and dimensional budgets.	_____	_____	☐
D05	Safety, reliability and security Hazard / failure-mode analysis, misuse scenarios, threat model, reliability targets and owned risk mitigations.	_____	_____	☐
D06	Manufacture, assemble, test and repair Material / process choices, tolerance stack-ups, assembly access, test access and lifecycle design reviews.	_____	_____	☐
D07	Verification, validation and compliance planning Requirement methods and limits, user-validation scenarios, qualification envelope and applicable compliance matrix.	_____	_____	☐
D08	Baseline and decision authority Reviewed design basis, recorded assumptions / rationale, unresolved issues with owners and approval for the next build.	_____	_____	☐

Decision: ☐ Ready ☐ Conditional ☐ Hold Approved by: _____ Date: _____

Open issues / conditions / owner / due date: _____

Next review / trigger: _____ Evidence index / baseline: _____

Build package readiness

Make the selected configuration reproducible by the intended builder.

Project: _____ Build / baseline: _____ Date: _____

Decision owner: _____ Suggested role: Engineering release authority / manufacturing lead

R ready | C conditional | H hold | N not applicable (explain why). Record evidence you can find and review.

ID	Check and expected evidence	Evidence reference	Item owner	R/C/H/N
B01	Released technical package Revision-controlled CAD, drawings, schematics, PCB fabrication files, BOM, firmware and reproducible build instructions.	_____	_____	☐
B02	Materials, finishes and dimensional controls Material grades, finishes, tolerances, critical characteristics, process constraints and inspection datums.	_____	_____	☐
B03	Procured parts and substitutions Approved manufacturer part numbers, sourcing details, alternates and limits on substitutions or deviations.	_____	_____	☐
B04	Assembly and fabrication instructions Build sequence, settings, fasteners / torques, adhesives, fixtures, tool access, handling and process safety.	_____	_____	☐
B05	Programming and provisioning Approved firmware / hashes, programming steps, device identity, authorized configuration and secure provisioning.	_____	_____	☐
B06	Inspection and acceptance procedures Unit / batch checks, measurable pass-fail criteria, sampling rationale where used, instruments and calibration needs.	_____	_____	☐
B07	As-designed and as-built traceability Release manifest; part / lot / serial records; hardware, firmware and procedure versions; recorded deviations.	_____	_____	☐
B08	Controlled build authorization Named approver, build purpose and quantity, applicable conditions, change-impact review and required re-verification.	_____	_____	☐

Decision: ☐ Ready ☐ Conditional ☐ Hold Approved by: _____ Date: _____

Open issues / conditions / owner / due date: _____

Next review / trigger: _____ Evidence index / baseline: _____

Supplier and tooling readiness

Establish that people, parts, processes and equipment can support the planned build.

Project: _____ Build / baseline: _____ Date: _____

Decision owner: _____ Suggested role: Supply-chain / manufacturing lead

R ready | C conditional | H hold | N not applicable (explain why). Record evidence you can find and review.

ID	Check and expected evidence	Evidence reference	Item owner	R/C/H/N
S01	Supplier capability and capacity Evidence of relevant process skills, quality capability, available capacity and supplier risk controls.	_____	_____	☐
S02	Availability and sourcing resilience Material / component availability, qualified alternates, minimum orders, lifecycle status and obsolescence exposure.	_____	_____	☐
S03	Procurement plan Purchase dates, lead times, delivery commitments, costs and contingencies aligned to build milestones.	_____	_____	☐
S04	Tooling, molds and test jigs Validated fixtures, molds, CAM / machine programs, assembly aids and test equipment for the intended configuration.	_____	_____	☐
S05	Measurement capability Trial-part measurements, gauge suitability, measurement uncertainty where relevant and current calibration records.	_____	_____	☐
S06	Process and quality controls Incoming, in-process and final checks; critical settings; reject, rework and nonconformance procedures.	_____	_____	☐
S07	People and facilities Training, work instructions, safe equipment, storage / handling, ESD controls where needed and facility readiness.	_____	_____	☐
S08	Trial-run resources and continuity Build materials and workforce available; bottlenecks identified; tooling maintenance, replacement and backup plans.	_____	_____	☐

Decision: ☐ Ready ☐ Conditional ☐ Hold Approved by: _____ Date: _____

Open issues / conditions / owner / due date: _____

Next review / trigger: _____ Evidence index / baseline: _____

Test readiness

Agree what will be proven, how it will be proven and which configuration the evidence applies to.

Project: _____ Build / baseline: _____ Date: _____

Decision owner: _____ Suggested role: Test lead / systems lead

R ready | C conditional | H hold | N not applicable (explain why). Record evidence you can find and review.

ID	Check and expected evidence	Evidence reference	Item owner	R/C/H/N
T01	Requirement-to-evidence matrix Each requirement has a method, acceptance limit, conditions, responsible owner and planned evidence reference.	_____	_____	☐
T02	Known test configuration Exact hardware, software, interfaces, instruments, scripts, environment and unit / lot identities recorded.	_____	_____	☐
T03	People, equipment and procedures Reviewed procedures, trained operators, available fixtures, calibrated instruments and adequate measurement capability.	_____	_____	☐
T04	Component verification Code reviews, unit tests and relevant inspection, analysis or demonstration for software and physical components.	_____	_____	☐
T05	Integration and interface verification Assembly, wiring, dimensions, protocols and interface behavior checked against controlled interface definitions.	_____	_____	☐
T06	System verification Functional and performance requirements checked over specified conditions, including limits, recovery and margins.	_____	_____	☐
T07	User validation Representative users, realistic scenarios and intended environments; usability evidence and resolved feedback.	_____	_____	☐
T08	Qualification, compliance and regression Applicable qualification / compliance evidence; security assessment or pentesting; impact-based regression and issue closure.	_____	_____	☐

Decision: ☐ Ready ☐ Conditional ☐ Hold Approved by: _____ Date: _____

Open issues / conditions / owner / due date: _____

Next review / trigger: _____ Evidence index / baseline: _____

Production readiness

Use for G1 before low-rate production and again for G2 before scaling production.

Project: _____ Build / baseline: _____ Date: _____

Decision owner: _____ Suggested role: Manufacturing lead / release authority

R ready | C conditional | H hold | N not applicable (explain why). Record evidence you can find and review.

ID	Check and expected evidence	Evidence reference	Item owner	R/C/H/N
P01	Representative pilot build Intended parts, materials, tooling, operators and process routes demonstrated with recorded build results.	_____	_____	☐
P02	First-article and dimensional evidence Critical dimensions, materials and workmanship inspected; discrepancies dispositioned and corrective actions verified.	_____	_____	☐
P03	Quality and repeatability Yield, scrap, rework, failure trends and relevant process-capability evidence meet the planned acceptance criteria.	_____	_____	☐
P04	Rate and capacity Measured cycle time, bottlenecks, staffing, equipment and supplier capacity support the proposed production rate.	_____	_____	☐
P05	Actual economics Updated BOM, labor, tooling, test, scrap and logistics costs compared with unit-cost and commercial targets.	_____	_____	☐
P06	Production acceptance Approved unit / batch checks executed; results, packaging checks and acceptance records retained before release.	_____	_____	☐
P07	Traceability and change control As-built / lot / serial records, controlled revisions, approved deviations and assessment of changes to qualification evidence.	_____	_____	☐
P08	Evidence-based production decision G1 / G2 decision, configuration and volume authorized; remaining conditions, owners and next review explicitly recorded.	_____	_____	☐

Decision: ☐ Ready ☐ Conditional ☐ Hold Approved by: _____ Date: _____

Open issues / conditions / owner / due date: _____

Next review / trigger: _____ Evidence index / baseline: _____

Delivery and support readiness

Plan support during design; confirm delivery readiness and maintain it through retirement.

Project: _____ Build / baseline: _____ Date: _____

Decision owner: _____ Suggested role: Product / service owner

R ready | C conditional | H hold | N not applicable (explain why). Record evidence you can find and review.

ID	Check and expected evidence	Evidence reference	Item owner	R/C/H/N
L01	Installation and user information Setup, operation, training, labels and accessible instructions validated for the intended users and context.	_____	_____	☐
L02	Packaging, storage and shipping Protection, identification, handling and transport / storage limits supported by appropriate packaging evidence.	_____	_____	☐
L03	Service, repair and spares Diagnostics, repair procedures / tools, spare parts, maintenance intervals and service configuration records.	_____	_____	☐
L04	Updates and security support Secure update / recovery process, vulnerability and incident handling, support ownership and communicated support period.	_____	_____	☐
L05	Returns and failure analysis Return / warranty workflow, field-failure records, root-cause analysis and verified corrective actions.	_____	_____	☐
L06	Customer and community feedback Feedback owners and backlog links for current-product improvements, future releases and go-to-market learning.	_____	_____	☐
L07	Obsolescence and continuity Supplier / component monitoring, alternatives, redesign triggers and an appropriate repair-stock or sourcing plan.	_____	_____	☐
L08	Retirement and end of life Communicated development / support end dates; decommissioning, data removal, disassembly, recycling and disposal plan.	_____	_____	☐

Decision: ☐ Ready ☐ Conditional ☐ Hold Approved by: _____ Date: _____

Open issues / conditions / owner / due date: _____

Next review / trigger: _____ Evidence index / baseline: _____