

ENGLISH FOR WORK / REQUIREMENTS / EVIDENCE / INTERFACES / DECISIONS

Engineering English

Challenge the assumption. Explain the evidence.



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Eight practical lessons. Eleven extended conversations.
Vocabulary, phrase banks, guided speaking, and explained answers.

Revised 2026 edition / Upper-intermediate to advanced

Your route through the book

01 Requirements and Constraints, page 4

Convert an ambiguous customer request into a measurable proposal while keeping unresolved conditions and approval visible.

02 Design Reviews and Technical Pushback, page 14

Challenge a release recommendation by identifying a specific evidence gap and proposing a bounded closure action.

03 Failure Modes and Reliability, page 26

Report a failure observation precisely, distinguish mechanism from cause, and propose evidence-led investigation language.

04 Testing, Validation, and Data Interpretation, page 39

Report prototype results with their sample, conditions, criterion, and limits while distinguishing verification from broader validation.

05 Manufacturability and Cost Engineering, page 52

Compare design costs on the same volume and cost basis while keeping manufacturability and approval separate from arithmetic.

06 Safety Factors and Compliance, page 63

Question a compliance claim by identifying the applicable requirement, analysis basis, evidence scope, and decision authority.

07 Field Issues and Customer Communication, page 75

Correct an unsupported causal statement, acknowledge customer impact, and give a useful next update without promising an unconfirmed resolution.

08 Systems Integration and Interface Control, page 86

Explain an interface mismatch using configuration, units, and affected evidence while coordinating a controlled integration decision.

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Suggested study range: B2-C1. This is an editorial study range, not a certified proficiency assessment.

Precision makes disagreement productive.

Engineering conversations move between customer needs, models, drawings, measurements, and decisions. A familiar word such as verified, robust, or compatible can mean different things to different teams. These cases develop the language for naming the exact claim, testing its basis, and explaining what remains unresolved without making the discussion personal.

Name the reference

A result needs a requirement, revision, condition, or comparison point. Identify the reference before saying the design passes, improves, or remains compatible.

"The result applies to revision B under the recorded test conditions."

Separate observation from explanation

A failed response is an observation. A suspected mechanism is an explanation to investigate. Preserve the distinction even when the hypothesis sounds convincing.

"The output dropped during the test; connector damage is not yet confirmed."

Make the trade-off explicit

Lower material cost can accompany higher assembly cost. A stronger part may add mass. State the comparison basis and the constraints instead of presenting one favorable number as the whole decision.

"Option B costs less at the stated volume after tooling is included."

Close with evidence and ownership

A meeting can identify a gap without closing it. Name who will supply the missing evidence, who reviews it, and what decision remains pending.

"Please attach the interface analysis before the release owner reviews closure."

Professional boundaries

Original fictional English practice, not engineering design guidance, safety certification, professional approval, or instructions for operating equipment. Numbers and technical cases are invented.

Actual design, testing, field action, and compliance decisions require qualified personnel, applicable requirements, approved procedures, and the relevant authority.

A Read the situation

LESSON 01 / REQUIREMENTS AND CONSTRAINTS

Convert an ambiguous customer request into a measurable proposal while keeping unresolved conditions and approval visible.

Lightweight compared with what?

Customer representative Julia asks engineer Wei for a lightweight, durable enclosure. Their meeting proposes a maximum mass of 1.2 kg for the empty enclosure including its cover and fasteners. Electronics are excluded. The proposed service life is five years, but operating temperature, humidity, handling conditions, and the verification method are unresolved. Nothing is approved. Wei must record the proposed mass limit accurately and avoid turning the life target into a demonstrated durability claim.

People: Julia, Customer representative; Wei, Design engineer.

Read the record

Choose one answer per question using the facts above.

1. What is included in the proposed mass limit?

- A. Shipping packaging and spare parts
- B. The empty enclosure, cover, and fasteners
- C. All installed electronics
- D. Only the removable cover

2. What is the status of five years?

- A. A demonstrated test result
- B. An approved warranty promise
- C. A measured failure-free period
- D. A proposed service-life target

3. Which condition is still open?

- A. Operating temperature
- B. The proposed 1.2 kg mass value
- C. The inclusion of fasteners
- D. The exclusion of electronics

[Answers and explanations, page 113](#)

B Vocabulary in use

CORE TERMS

stakeholder need

The capability or outcome a stakeholder wants.
capture the stakeholder need

design constraint

A limit on available design choices.
work within a design constraint

maximum mass

The greatest permitted mass under a stated boundary.
specify maximum mass

operating envelope

The range of conditions for intended operation.
define the operating envelope

duty cycle

The pattern of operation and rest over time.
specify the duty cycle

acceptance criterion

A condition used to judge whether a result is acceptable.
agree an acceptance criterion

design requirement

A specified condition the design must satisfy.
define a design requirement

mass budget

The planned allocation of allowable mass.
allocate the mass budget

system boundary

The line defining what is included in the system.
define the system boundary

service life

The intended period of use under specified conditions.
state the service life

environmental condition

A surrounding condition affecting operation or storage.
document environmental conditions

verification method

The means used to check a stated requirement.
select a verification method

Say it in context

Stress the highlighted expression. Keep the surrounding words connected; pause at the end of the phrase.

stakeholder need **STAKEHOLDER NEED**

capture the stakeholder need

Keep the meaning precise: The capability or outcome a stakeholder wants.

system boundary **SYSTEM BOUNDARY**

define the system boundary

Keep the meaning precise: The line defining what is included in the system.

B Precision and professional shorthand

EXTEND YOUR RANGE

testability

The extent to which a claim can be checked by testing.

improve testability

derived requirement

A requirement developed from higher-level needs or analysis.

justify a derived requirement

threshold

A stated boundary for an acceptable result.

specify the threshold

assumption register

A record of unverified premises used in planning or design.

update the assumption register

baseline

An approved reference placed under change control.

establish a baseline

rationale

The reason supporting a requirement or decision.

record the rationale

requirement allocation

Assignment of a requirement to a system element.

review requirement allocation

design margin

Allowance between a predicted value and a defined limit.

preserve design margin

objective value

A desired value beyond a minimum acceptable level.

distinguish threshold and objective

traceability

Recorded connections between needs, requirements, and evidence.

maintain traceability

ambiguity

Wording that permits more than one interpretation.

resolve ambiguity

requirement owner

The role responsible for maintaining a requirement.

identify the requirement owner

Say it in context

Stress the highlighted expression. Keep the surrounding words connected; pause at the end of the phrase.

verification method VERIFICATION METHOD

select a verification method

Keep the meaning precise: The means used to check a stated requirement.

threshold THRESHOLD

specify the threshold

Keep the meaning precise: A stated boundary for an acceptable result.

Phrases that move the work forward

Clarify the adjective

What maximum mass would count as lightweight?

Exclude explicitly

Electronics are outside this mass boundary.

Qualify the status

This is a proposal, not an approved requirement.

Clarify the life claim

Five years under which use and maintenance conditions?

Separate target from evidence

The service-life target is not a demonstrated result.

Keep the requirement singular

Separate the mass limit from the service-life requirement.

Connect the need

Which customer task makes this limit necessary?

Request ownership

Who will confirm the environmental requirements?

Set the boundary

Does that value include the cover and fasteners?

State the proposal

We propose a maximum mass of 1.2 kg.

Ask about conditions

What operating temperature range must the enclosure withstand?

Identify a missing input

The handling conditions have not been specified.

Ask how to check

Which verification method will support acceptance?

Protect the boundary

A packaging change should not silently alter the measured assembly.

Record a premise

Put the unconfirmed condition in the assumption register.

Close accurately

We have clarified the proposal, but approval is still pending.

Precision in real exchanges

Purpose: State the proposal

Useful wording: We propose a maximum mass of 1.2 kg.

Purpose: Qualify the status

Useful wording: This is a proposal, not an approved requirement.

D Choose the response that fits

Choose one response for each situation. Preserve the facts, the decision boundary, and the purpose of the exchange.

1. Which statement accurately records the mass proposal?

- A.** Approximately 1.2 kg for any version of the complete product
- B.** A guaranteed 1.2 kg for packaging and all components
- C.** An approved mass limit for electronics alone
- D.** Maximum 1.2 kg for the empty enclosure including cover and fasteners, excluding electronics

2. Which sentence avoids overstating durability?

- A.** Five years is the proposed service life; operating conditions and verification remain open.
- B.** The enclosure has already survived five years.
- C.** The proposal proves performance in every environment.
- D.** A mass limit establishes service life automatically.

3. A colleague needs the term for this meaning: The planned allocation of allowable mass. Which term fits?

- A.** derived requirement
- B.** baseline
- C.** mass budget
- D.** duty cycle

D Choose the response that fits / continued

4. Rebuild the exchange from "Lightweight compared with what?". Julia: "For durability, our commercial team has suggested five years. They have not told us the expected operating temperature or how often the unit will be handled." Wei: [missing response] Julia: "Could we leave the conditions to the design team? I do not want to slow the project by asking the customer for every detail immediately." Which response belongs in the gap?

- A.** Let us define the maximum mass. Would 1.2 kilograms be the proposed upper limit, and what exactly should be included when we measure it?
- B.** Five years is a proposed service life, not yet a demonstrated result. We need the use conditions before selecting evidence that could support the requirement.
- C.** Yes. The verification method must suit the requirement. We should agree what is checked, on which configuration, and what evidence the acceptance decision will use.
- D.** We will establish the baseline only through the agreed approval process. Today's useful result is a precise proposal and an explicit list of remaining decisions.

[Answers and explanations, page 113](#)

One useful distinction

Mass is not the same as the mass of the fully populated product. The proposal includes the enclosure, cover, and fasteners but excludes electronics. A five-year target needs defined use conditions and a suitable evidence plan before it can support a durability claim.

E Conversation

Lightweight compared with what?

Lightweight compared with what?

Complete the numbered gaps. Use each bank entry once; some entries contain several words.

WORD AND PHRASE BANK

maximum mass / assumption register / requirement owner / verification method /
baseline / system boundary / rationale / operating envelope / service life / traceability

- 01 **Julia:** We need the new enclosure to be lightweight and durable. The previous proposal felt too heavy, but our brief does not yet give a numerical limit.
- 02 **Wei:** Let us define the ¹ _____. Would 1.2 kilograms be the proposed upper limit, and what exactly should be included when we measure it?
- 03 **Julia:** Use that value for discussion. I mean the empty enclosure with its cover and fasteners, not the electronics that our team will install later.
- 04 **Wei:** Then the ² _____ includes those three items and excludes electronics. I will put that beside the number so nobody compares it with a populated assembly.
- 05 **Julia:** For durability, our commercial team has suggested five years. They have not told us the expected operating temperature or how often the unit will be handled.
- 06 **Wei:** Five years is a proposed ³ _____, not yet a demonstrated result. We need the use conditions before selecting evidence that could support the requirement.
- 07 **Julia:** Could we leave the conditions to the design team? I do not want to slow the project by asking the customer for every detail immediately.
- 08 **Wei:** We can propose an ⁴ _____, but the customer needs to confirm it. Otherwise we might optimize for conditions that do not match the actual installation.
- 09 **Julia:** I will ask about temperature, humidity, and handling. Some units may move between workstations, so we should not assume they all stay fixed in one installation.
- 10 **Wei:** Record each unresolved premise in the ⁵ _____. Give it an owner and a confirmation point rather than hiding it inside a confident statement about durability.

Conversation continues on the next page.

Lightweight compared with what?

CONVERSATION / CONTINUED

- 11 **Julia:** Once the conditions are clear, I assume we will need a way to show that the proposal has been met, not just a convincing description.
- 12 **Wei:** Yes. The ⁶ _____ must suit the requirement. We should agree what is checked, on which configuration, and what evidence the acceptance decision will use.
- 13 **Julia:** I also want the specification to preserve why we chose the limit. A later reviewer may otherwise change it without understanding the installation problem behind it.
- 14 **Wei:** Keep the ⁷ _____ with the requirement. That helps reviewers assess whether a proposed change still serves the customer need instead of debating the number in isolation.
- 15 **Julia:** Let us send the precise mass proposal now and mark the environmental questions as open. I do not want the clear mass limit to make the whole specification look settled.
- 16 **Wei:** Correct. Clear ⁸ _____ will connect the need, the agreed wording, and the eventual evidence. It also makes the unresolved links visible during review.
- 17 **Julia:** I will send the customer the proposed boundary and the missing questions. Please do not label the specification approved until their review is complete.
- 18 **Wei:** We will establish the ⁹ _____ only through the agreed approval process. Today's useful result is a precise proposal and an explicit list of remaining decisions.
- 19 **Julia:** Good. I can explain that progress without claiming the enclosure has already met the five-year target. Who should keep the environmental questions moving?
- 20 **Wei:** Name a ¹⁰ _____ for that follow-up. The record should say who confirms the conditions and when, so the open questions do not disappear between teams.

CHECK THE GAPS

1. maximum mass / 2. system boundary / 3. service life / 4. operating envelope / 5. assumption register / 6. verification method / 7. rationale / 8. traceability / 9. baseline / 10. requirement owner

[Why these answers fit, page 114](#)

F Check accuracy and scope

Lightweight compared with what?

Return to the case

Customer representative Julia asks engineer Wei for a lightweight, durable enclosure. Their meeting proposes a maximum mass of 1.2 kg for the empty enclosure including its cover and fasteners. Electronics are excluded. The proposed service life is five years, but operating temperature, humidity, handling conditions, and the verification method are unresolved. Nothing is approved. Wei must record the proposed mass limit accurately and avoid turning the life target into a demonstrated durability claim.

Choose one answer per question. Use the case facts and keep any uncertainty or limits intact.

1. What should happen to unresolved environmental assumptions?

- A. Convert each into a favorable test result.
- B. Let every supplier choose a different interpretation without recording it.
- C. Record them with owners for confirmation.
- D. Remove them to make the requirement look finished.

2. A prototype meets the proposed mass boundary at 1.15 kg. What does that establish about the five-year target?

- A. The operating envelope is automatically approved.
- B. The electronics must be included because the measured mass is below the limit.
- C. Nothing by itself; a mass result does not demonstrate service life under undefined conditions.
- D. Five-year life is verified because 1.15 is below 1.2.

[Answers and explanations, page 115](#)

Listen for the distinction

Switch roles. Keep five years as proposed service life while operating conditions, verification, and approval remain open.

Ask for the boundary behind the adjective

A request for a robust or lightweight product communicates a preference, not a complete acceptance basis. Ask what is included, under which conditions, and how success will be checked. Keep the discussion focused on the product rather than criticizing the customer for imprecise language.

F Say it / transfer to a new case

A boundary changes the meaning

A proposal limits an empty housing with lid and screws to 0.8 kg. Batteries are excluded. The operating humidity and acceptance test are not yet agreed. Approval remains pending.

Complete the four gaps. With a partner, read alternate roles, then switch. Studying alone, read both roles and pause before each response.

WORD AND PHRASE BANK

unresolved / included / excluded / baseline

- 01 **Engineer:** The lid and screws are ¹ _____.
- 02 **Customer:** The batteries are ² _____.
- 03 **Engineer:** Humidity remains ³ _____.
- 04 **Customer:** This is a proposal, not an approved ⁴ _____.

CHECK THE GAPS

1. included / 2. excluded / 3. unresolved / 4. baseline

[Why these answers fit, page 116](#)

Rebuild the exchange

Choose the missing response. Read the completed three-turn exchange aloud, changing roles on the second reading.

1. Rebuild the exchange from "Lightweight compared with what?". Julia: "I also want the specification to preserve why we chose the limit. A later reviewer may otherwise change it without understanding the installation problem behind it." Wei: [missing response] Julia: "Let us send the precise mass proposal now and mark the environmental questions as open. I do not want the clear mass limit to make the whole specification look settled." Which response belongs in the gap?

- A.** Keep the rationale with the requirement. That helps reviewers assess whether a proposed change still serves the customer need instead of debating the number in isolation.
- B.** Then the system boundary includes those three items and excludes electronics. I will put that beside the number so nobody compares it with a populated assembly.
- C.** Record each unresolved premise in the assumption register. Give it an owner and a confirmation point rather than hiding it inside a confident statement about durability.
- D.** We can propose an operating envelope, but the customer needs to confirm it. Otherwise we might optimize for conditions that do not match the actual installation.

[Answers and explanations, page 117](#)

A Read the situation

LESSON 02 / DESIGN REVIEWS AND TECHNICAL PUSHBACK

Challenge a release recommendation by identifying a specific evidence gap and proposing a bounded closure action.

The drawing fits; the evidence is missing

At a design review, mechanical lead Ahmed and reviewer Clara examine an enclosure interface. The CAD model shows 2 mm nominal clearance. Requirement R-14 specifies at least 1 mm clearance across the approved dimensional tolerances. The tolerance stack-up has not been documented, and the supplier drawing revision used in the model is unconfirmed. The chair is preparing to recommend release. Clara must distinguish nominal fit from verified minimum clearance and record a specific closure action without claiming the design has already failed.

People: Ahmed, Mechanical lead; Clara, Design reviewer.

Read the record

Choose one answer per question using the facts above.

1. What does the CAD model currently show?

- A. The approved supplier revision
- B. A completed tolerance analysis
- C. 2 mm nominal clearance
- D. A verified 1 mm minimum across all tolerances

2. What does R-14 require?

- A. At least 1 mm across approved dimensional tolerances
- B. Exactly 2 mm in every assembly
- C. A nominal value greater than zero only
- D. An undocumented supplier agreement

3. What is not established?

- A. Whether the minimum clearance meets R-14
- B. Whether the CAD view shows a nominal gap
- C. Whether R-14 contains a numerical limit
- D. Whether a release recommendation is being prepared

[Answers and explanations, page 118](#)

B Vocabulary in use

CORE TERMS

design review

A structured examination of a design and its supporting evidence.

conduct a design review

nominal dimension

The stated reference dimension before permitted variation.

check the nominal dimension

interference

Unwanted overlap or contact between parts.

identify potential interference

tolerance stack-up

The combined dimensional variation affecting an assembly condition.

calculate the tolerance stack-up

datum

A reference used to establish dimensional relationships.

identify the datum

CAD model

A computer-aided design representation of geometry.

update the CAD model

review package

The drawings, analyses, and records provided for review.

complete the review package

clearance

The space between adjacent parts.

verify minimum clearance

dimensional tolerance

The permitted variation in a specified dimension.

apply dimensional tolerances

worst-case analysis

An assessment using the most adverse allowed combination.

document a worst-case analysis

mating surface

A surface that joins or interfaces with another part.

inspect the mating surface

drawing revision

The identified version of an engineering drawing.

confirm the drawing revision

Say it in context

Stress the highlighted expression. Keep the surrounding words connected; pause at the end of the phrase.

design review **DESIGN REVIEW**

conduct a design review

Keep the meaning precise: A structured examination of a design and its supporting evidence.

dimensional tolerance **DIMENSIONAL TOLERANCE**

apply dimensional tolerances

Keep the meaning precise: The permitted variation in a specified dimension.

B Precision and professional shorthand

EXTEND YOUR RANGE

assumption log

A record of premises used in an analysis.

review the assumption log

closure evidence

Information demonstrating that an open item is resolved.

attach closure evidence

technical objection

A reasoned challenge to a technical claim or decision.

state a technical objection

release recommendation

Advice that a design proceed to a release decision.

qualify a release recommendation

conditional approval

Approval explicitly subject to specified conditions, where allowed.

document conditional approval

design freeze

A defined point after which design changes require controls.

prepare for design freeze

open item

An unresolved matter recorded for follow-up.

assign an open item

review action

A task assigned as a result of a review.

record a review action

dissent

A recorded difference of professional judgment.

document unresolved dissent

release authority

The role authorized to approve the relevant release.

identify the release authority

concurrence

Agreement with a stated position or disposition.

obtain reviewer concurrence

action closure

Formal resolution of an assigned review task.

verify action closure

Say it in context

Stress the highlighted expression. Keep the surrounding words connected; pause at the end of the phrase.

drawing revision DRAWING REVISION

confirm the drawing revision

Keep the meaning precise: The identified version of an engineering drawing.

technical objection TECHNICAL OBJECTION

state a technical objection

Keep the meaning precise: A reasoned challenge to a technical claim or decision.

Phrases that move the work forward

Locate the concern

My concern is the evidence for R-14.

Distinguish the claim

Nominal clearance is not minimum clearance across tolerances.

Check the reference

Which supplier drawing revision does the model use?

State the gap

We cannot yet verify the required minimum.

Define closure

Closure needs a reviewed result against R-14.

Keep the decision visible

The release recommendation remains unresolved.

Clarify conditions

What restrictions would apply to conditional approval?

Prevent silent closure

Do not close the item because the meeting has ended.

Acknowledge the work

The nominal geometry is clear in the model.

Ask for the analysis

Where is the documented tolerance stack-up?

Avoid alleging failure

I am not saying interference has been demonstrated.

Bound the action

Confirm the revision and attach the stack-up for this interface.

Name responsibility

Ahmed will prepare the analysis for review.

Separate meeting roles

Reviewer concurrence is not automatically release authority.

Preserve disagreement

Record the technical objection with its evidence basis.

Invite resolution

What evidence would let us resolve this concern today?

Precision in real exchanges

Purpose: Ask for the analysis

Useful wording: Where is the documented tolerance stack-up?

Purpose: Check the reference

Useful wording: Which supplier drawing revision does the model use?

D Choose the response that fits

Choose one response for each situation. Preserve the facts, the decision boundary, and the purpose of the exchange.

1. Which review comment is best supported?

- A.** The design definitely interferes because no stack-up is attached.
- B.** The nominal gap alone verifies every allowed assembly.
- C.** The supplier revision cannot affect interface review.
- D.** R-14 remains unverified pending the stack-up and revision confirmation.

2. Which closure action addresses both missing inputs for R-14?

- A.** Confirm the supplier drawing revision and review the interface tolerance stack-up against the 1 mm minimum.
- B.** Measure the nominal CAD gap again and mark the minimum verified.
- C.** Confirm the drawing filename without checking the tolerances used.
- D.** Obtain meeting attendance signatures and treat them as clearance evidence.

3. A colleague needs the term for this meaning: The space between adjacent parts. Which term fits?

- A.** clearance
- B.** conditional approval
- C.** closure evidence
- D.** datum

D Choose the response that fits / continued

4. Rebuild the exchange from "The drawing fits; the evidence is missing". Ahmed: "That is a fair distinction. The model also came from the supplier file, but I cannot confirm which drawing issue was used without checking our records." Clara: [missing response] Ahmed: "Please replace check fit with the actual task: confirm the supplier revision and assess minimum clearance against R-14. I can own that analysis." Which response belongs in the gap?

- A.** A technical objection should be answerable. Here the requirement, missing analysis, and configuration question make the concern concrete enough for us to resolve.
- B.** Confirm the drawing revision before completing the calculation. An analysis of an obsolete interface could look convincing while answering the wrong configuration question.
- C.** My concern is the tolerance stack-up. R-14 applies across the permitted dimensional variation, and the supporting calculation is not in the review package.
- D.** Nor do I. Nominal clearance is two millimeters. The minimum remains unverified, which is different from saying that interference has been observed or established.

[Answers and explanations, page 118](#)

One useful distinction

A nominal 2 mm gap does not establish the minimum gap across permitted variation. Missing evidence also does not prove physical interference. The supported finding is that R-14 is not yet verified on a confirmed configuration.

E Conversation

The drawing fits; the evidence is missing

The drawing fits; the evidence is missing

Complete the numbered gaps. Use each bank entry once; some entries contain several words.

WORD AND PHRASE BANK

release authority / tolerance stack-up / drawing revision / Conditional approval /
closure evidence / review action / technical objection / open item / Nominal clearance /
Action closure

- 01 **Ahmed:** The model shows a two-millimeter gap, and the chair wants to recommend release today. Do you have a specific concern, or can we close the review?
- 02 **Clara:** My concern is the ¹ _____. R-14 applies across the permitted dimensional variation, and the supporting calculation is not in the review package.
- 03 **Ahmed:** The nominal geometry is comfortably above one millimeter. I agree that it does not show every combination, but I do not want the team to hear that the design has failed.
- 04 **Clara:** Nor do I. ² _____ is two millimeters. The minimum remains unverified, which is different from saying that interference has been observed or established.
- 05 **Ahmed:** That is a fair distinction. The model also came from the supplier file, but I cannot confirm which drawing issue was used without checking our records.
- 06 **Clara:** Confirm the ³ _____ before completing the calculation. An analysis of an obsolete interface could look convincing while answering the wrong configuration question.
- 07 **Ahmed:** Please replace check fit with the actual task: confirm the supplier revision and assess minimum clearance against R-14. I can own that analysis.
- 08 **Clara:** Exactly. Make it a ⁴ _____ with an owner and a review point. The task is narrow enough to complete without reopening unrelated parts of the design.
- 09 **Ahmed:** I can own the analysis. I will identify the confirmed supplier revision, state the tolerance assumptions, and present the resulting minimum against R-14.
- 10 **Clara:** That provides the intended ⁵ _____. The reviewer still needs to assess the result; attaching a file is not itself the same as resolving the concern.

Conversation continues on the next page.

The drawing fits; the evidence is missing

CONVERSATION / CONTINUED

- 11 **Ahmed:** Could the chair record conditional approval and allow the release team to continue? I want to avoid delaying work that does not depend on this interface.
- 12 **Clara:** ⁶ _____ is only available if our process permits it. The record would need clear restrictions and the appropriate decision maker, not a casual promise to finish later.
- 13 **Ahmed:** I will ask the chair to separate any permitted preparatory work from release. We should not imply that every downstream activity has the same dependency.
- 14 **Clara:** Agreed. Identify the ⁷ _____ and let that role decide on the recorded basis. My review comment should not be mistaken for unilateral approval or rejection.
- 15 **Ahmed:** That is a concern I can answer. Keep the comment tied to the missing stack-up and revision, so the team knows exactly what needs closing.
- 16 **Clara:** A ⁸ _____ should be answerable. Here the requirement, missing analysis, and configuration question make the concern concrete enough for us to resolve.
- 17 **Ahmed:** I will revise the minutes to keep the interface item open. The release recommendation will remain unresolved until the evidence and required review are available.
- 18 **Clara:** Keep that ⁹ _____ visible in the action list. A meeting ending or an owner accepting the task must not make its status appear complete.
- 19 **Ahmed:** Once the reviewed analysis is available, we can record the result and route the recommendation to the authorized decision maker with any remaining conditions.
- 20 **Clara:** Yes. ¹⁰ _____ should identify the evidence and reviewer. That gives the release decision a traceable basis while preserving what the team actually established.

CHECK THE GAPS

1. tolerance stack-up / 2. Nominal clearance / 3. drawing revision / 4. review action / 5. closure evidence / 6. Conditional approval / 7. release authority / 8. technical objection / 9. open item / 10. Action closure

[Why these answers fit, page 119](#)

F Check accuracy and scope

The drawing fits; the evidence is missing

Return to the case

At a design review, mechanical lead Ahmed and reviewer Clara examine an enclosure interface. The CAD model shows 2 mm nominal clearance. Requirement R-14 specifies at least 1 mm clearance across the approved dimensional tolerances. The tolerance stack-up has not been documented, and the supplier drawing revision used in the model is unconfirmed. The chair is preparing to recommend release. Clara must distinguish nominal fit from verified minimum clearance and record a specific closure action without claiming the design has already failed.

Choose one answer per question. Use the case facts and keep any uncertainty or limits intact.

1. What may the minutes record now?

- A. A measured clearance failure without measurement or analysis
- B. Supplier concurrence that has not been received
- C. An open verification item and its assigned follow-up
- D. Unconditional release approval inferred from meeting attendance

2. What would justify closing the item?

- A. Repeating the 2 mm nominal value more confidently
- B. A later meeting date without new evidence
- C. A statement that similar designs usually fit
- D. Reviewed evidence for the confirmed configuration against R-14

[Answers and explanations, page 121](#)

Listen for the distinction

Switch roles. Request the confirmed supplier revision and reviewed stack-up without announcing interference or release approval.

Push back on the claim, not the person

A direct technical challenge can be cooperative when it identifies the requirement, the missing evidence, and the decision affected. State what would resolve the concern. Avoid either approving from politeness or treating an incomplete analysis as proof that a colleague designed a defective product.

F Say it / transfer to a new case

A nominal fit is not a verified minimum

A model shows 3 mm nominal clearance. The requirement specifies at least 1 mm across tolerances. The stack-up is missing, and the supplier revision is not confirmed.

Complete the four gaps. With a partner, read alternate roles, then switch. Studying alone, read both roles and pause before each response.

WORD AND PHRASE BANK

nominal / unverified / evidence / confirmation

- 01 **Reviewer:** Three millimeters is the ¹ _____ clearance.
- 02 **Engineer:** The supplier revision needs ² _____.
- 03 **Reviewer:** The minimum remains ³ _____.
- 04 **Engineer:** The item closes with reviewed ⁴ _____.

CHECK THE GAPS

1. nominal / 2. confirmation / 3. unverified / 4. evidence

[Why these answers fit, page 121](#)

Rebuild the exchange

Choose the missing response. Read the completed three-turn exchange aloud, changing roles on the second reading.

1. Rebuild the exchange from "The drawing fits; the evidence is missing". Ahmed: "I will ask the chair to separate any permitted preparatory work from release. We should not imply that every downstream activity has the same dependency." Clara: [missing response] Ahmed: "That is a concern I can answer. Keep the comment tied to the missing stack-up and revision, so the team knows exactly what needs closing." Which response belongs in the gap?

- A.** Agreed. Identify the release authority and let that role decide on the recorded basis. My review comment should not be mistaken for unilateral approval or rejection.
- B.** Exactly. Make it a review action with an owner and a review point. The task is narrow enough to complete without reopening unrelated parts of the design.
- C.** Keep that open item visible in the action list. A meeting ending or an owner accepting the task must not make its status appear complete.
- D.** That provides the intended closure evidence. The reviewer still needs to assess the result; attaching a file is not itself the same as resolving the concern.

[Answers and explanations, page 122](#)

Review 1 / Meaning and context

Use language from the lessons you have completed. Choose one answer per question.

Case file

Revisit "Requirements and Constraints" and "Design Reviews and Technical Pushback". Choose precise terminology, then reconstruct the missing responses using both neighboring turns. The final two questions also revisit earlier conversations.

1. A colleague needs the term for this meaning: A limit on available design choices. Which term fits?

- A. requirement allocation
- B. design constraint
- C. traceability
- D. service life

2. A colleague needs the term for this meaning: An assessment using the most adverse allowed combination. Which term fits?

- A. release recommendation
- B. assumption log
- C. design review
- D. worst-case analysis

3. Rebuild the exchange from "Lightweight compared with what?". Julia: "I will ask about temperature, humidity, and handling. Some units may move between workstations, so we should not assume they all stay fixed in one installation." Wei: [missing response] Julia: "Once the conditions are clear, I assume we will need a way to show that the proposal has been met, not just a convincing description." Which response belongs in the gap?

- A. Keep the rationale with the requirement. That helps reviewers assess whether a proposed change still serves the customer need instead of debating the number in isolation.
- B. Then the system boundary includes those three items and excludes electronics. I will put that beside the number so nobody compares it with a populated assembly.
- C. We can propose an operating envelope, but the customer needs to confirm it. Otherwise we might optimize for conditions that do not match the actual installation.
- D. Record each unresolved premise in the assumption register. Give it an owner and a confirmation point rather than hiding it inside a confident statement about durability.

Review 1 / Meaning and context / continued

4. Rebuild the exchange from "The drawing fits; the evidence is missing". Ahmed: "I will revise the minutes to keep the interface item open. The release recommendation will remain unresolved until the evidence and required review are available." Clara: [missing response] Ahmed: "Once the reviewed analysis is available, we can record the result and route the recommendation to the authorized decision maker with any remaining conditions." Which response belongs in the gap?

- A.** Keep that open item visible in the action list. A meeting ending or an owner accepting the task must not make its status appear complete.
- B.** Nor do I. Nominal clearance is two millimeters. The minimum remains unverified, which is different from saying that interference has been observed or established.
- C.** That provides the intended closure evidence. The reviewer still needs to assess the result; attaching a file is not itself the same as resolving the concern.
- D.** Agreed. Identify the release authority and let that role decide on the recorded basis. My review comment should not be mistaken for unilateral approval or rejection.

[Answers and explanations, page 153](#)

A Read the situation

LESSON 03 / FAILURE MODES AND RELIABILITY

Report a failure observation precisely, distinguish mechanism from cause, and propose evidence-led investigation language.

One interruption, several possible explanations

During a planned 60-minute bench run, sample S7 stops producing an output at minute 46. Test engineer Grace and reliability engineer Pavel review the event. The failure has not been reproduced. The test setup has not been checked, and connector damage is only a hypothesis. The team has not established a population failure rate or a corrective action. Grace must preserve the result and test records while preventing a draft report from naming connector damage as the confirmed root cause.

People: Grace, Test engineer; Pavel, Reliability engineer.

Read the record

Choose one answer per question using the facts above.

1. What was directly observed?

- A. Connector damage was confirmed by inspection.
- B. Every sample failed before an hour.
- C. The test setup passed all checks.
- D. S7 stopped producing an output at minute 46.

2. Which statement accurately describes the cause?

- A. The component population is known to be defective.
- B. Connector damage is an unconfirmed hypothesis.
- C. Connector damage is the established root cause.
- D. The test fixture has been ruled out.

3. What cannot be calculated from the supplied facts alone?

- A. The planned run duration
- B. Whether the sample reached the full planned duration
- C. A representative population failure rate
- D. The time of the observed interruption

[Answers and explanations, page 123](#)

B Vocabulary in use

CORE TERMS

failure mode

The way an item fails to perform its required function.

describe the failure mode

failure mechanism

The physical or other process producing a failure.

investigate the failure mechanism

hypothesis

A proposed explanation that requires testing.

test a hypothesis

intermittent fault

A fault that appears and disappears under some conditions.

investigate an intermittent fault

repeatability

Agreement of repeated measurements under the same stated conditions.

check repeatability

test fixture

Equipment that holds or connects the item during testing.

inspect the test fixture

failure effect

The consequence of a failure at a stated level.

assess the failure effect

root cause

An underlying cause supported by an appropriate investigation.

establish the root cause

anomaly

An observed departure from expected behavior.

record an anomaly

reproducibility

Measurement precision under specified changed conditions, such as different laboratories or operators.

assess reproducibility

test setup

The equipment and arrangement used for a test.

verify the test setup

failure analysis

Investigation of evidence about a failure and its causes.

commission failure analysis

Say it in context

Stress the highlighted expression. Keep the surrounding words connected; pause at the end of the phrase.

failure mode **FAILURE MODE**

describe the failure mode

Keep the meaning precise: The way an item fails to perform its required function.

anomaly **ANOMALY**

record an anomaly

Keep the meaning precise: An observed departure from expected behavior.

B Precision and professional shorthand

EXTEND YOUR RANGE

fault isolation

Narrowing a fault to a component, location, or cause.

support fault isolation

event log

A time-ordered record of system or test events.

export the event log

containment

An immediate measure to limit exposure while investigation continues.

define containment

recurrence

Reappearance of a previously observed problem.

monitor recurrence

severity

The seriousness of a stated consequence.

assess severity

detectability

The ability of controls to identify a condition before its consequence.

assess detectability

diagnostic evidence

Information used to distinguish possible explanations.

preserve diagnostic evidence

specimen

An identified item submitted for examination or testing.

preserve the specimen

corrective action

An action addressing an established cause to prevent recurrence.

evaluate corrective action

FMEA

Failure mode and effects analysis, a structured review of possible failures and consequences.

update the FMEA

occurrence

The likelihood or frequency of a failure cause or event on a defined basis.

estimate occurrence

residual uncertainty

What remains unknown after available evidence is considered.

state residual uncertainty

Say it in context

Stress the highlighted expression. Keep the surrounding words connected; pause at the end of the phrase.

failure analysis FAILURE ANALYSIS

commission failure analysis

Keep the meaning precise: Investigation of evidence about a failure and its causes.

containment CONTAINMENT

define containment

Keep the meaning precise: An immediate measure to limit exposure while investigation continues.

Phrases that move the work forward

State the observation

S7 stopped producing an output at minute 46.

Separate cause from symptom

Loss of output is the observed mode, not the confirmed cause.

Name missing checks

The test setup has not yet been checked.

Protect the record

Preserve the sample identification and event log.

Keep the result

An unresolved cause does not erase the observed interruption.

Separate action types

Containment can precede a confirmed corrective action.

Clarify recurrence

Has the same mode reappeared under documented conditions?

State the uncertainty

The mechanism remains unresolved.

Preserve the duration

The planned run was 60 minutes.

Qualify the explanation

Connector damage is one hypothesis under investigation.

Avoid premature exclusion

We have not ruled out a fixture-related explanation.

Request discriminating evidence

Which observation would distinguish the competing explanations?

Limit the inference

This case does not establish a population failure rate.

Avoid a false fix

A replacement alone would not prove the cause was removed.

Use FMEA carefully

Link the mode to its possible effects and causes.

Close the update

Report the event, current hypotheses, next checks, and review point.

Precision in real exchanges

Purpose: Qualify the explanation

Useful wording: Connector damage is one hypothesis under investigation.

Purpose: Name missing checks

Useful wording: The test setup has not yet been checked.

D Choose the response that fits

Choose one response for each situation. Preserve the facts, the decision boundary, and the purpose of the exchange.

1. Which draft sentence should replace "connector damage caused the failure"?

- A.** The failure rate is one per 46 minutes for every unit.
- B.** S7 lost output at minute 46; connector damage remains a hypothesis.
- C.** S7 probably worked normally because the setup is unchecked.
- D.** All connectors in the product are defective.

2. Why preserve the event log and sample identity?

- A.** They establish that every later sample will behave identically.
- B.** They connect the investigation to the actual event and configuration.
- C.** They automatically prove which component caused the interruption.
- D.** They replace all further diagnostic work.

3. A colleague needs the term for this meaning: An underlying cause supported by an appropriate investigation. Which term fits?

- A.** root cause
- B.** repeatability
- C.** severity
- D.** event log

D Choose the response that fits / continued

4. Rebuild the exchange from "One interruption, several possible explanations".

Grace: "The setup checks are still open too. Can we examine the fixture and connection without treating either as the explanation before we have the evidence?"

Pavel: [missing response] **Grace:** "I have S7's identifier, the event time, and the configuration details. What other original records should I attach before the team starts the investigation?" Which response belongs in the gap?

- A.** Preserve the event log as well. We need the original sequence, including anything recorded before the output stopped, rather than a summary written from memory.
- B.** Start with the failure mode. Loss of output is what we observed. Connector damage is a proposed explanation, and the wording needs to preserve that distinction.
- C.** Treat it as a hypothesis. Prior experience can guide the investigation without allowing us to write the conclusion before examining this sample and its records.
- D.** Review the test setup under the approved process. That is part of interpreting the event, not a reason to dismiss the sample interruption as inconvenient.

[Answers and explanations, page 123](#)

One useful distinction

The observed mode is loss of output, not connector damage. A connector problem might explain the event, but it remains a hypothesis. Checking the setup is necessary to interpret the result; it does not justify deleting an inconvenient observation.

E Conversation

One interruption, several possible explanations

One interruption, several possible explanations

Complete the numbered gaps. Use each bank entry once; some entries contain several words.

WORD AND PHRASE BANK

failure mode / failure effect / failure analysis / event log / hypothesis / corrective action
/ containment / residual uncertainty / FMEA / test setup

- 01 **Grace:** S7 stopped producing an output at minute forty-six of the planned hour. The draft report says connector damage caused the failure, but we have not examined that explanation yet.
- 02 **Pavel:** Start with the ¹ _____. Loss of output is what we observed. Connector damage is a proposed explanation, and the wording needs to preserve that distinction.
- 03 **Grace:** The team has seen similar symptoms before, which is why the explanation sounds persuasive. I do not want to ignore their experience, but this event has not been reproduced.
- 04 **Pavel:** Treat it as a ² _____. Prior experience can guide the investigation without allowing us to write the conclusion before examining this sample and its records.
- 05 **Grace:** The setup checks are still open too. Can we examine the fixture and connection without treating either as the explanation before we have the evidence?
- 06 **Pavel:** Review the ³ _____ under the approved process. That is part of interpreting the event, not a reason to dismiss the sample interruption as inconvenient.

E Conversation / continued

- 07 **Grace:** I have S7's identifier, the event time, and the configuration details. What other original records should I attach before the team starts the investigation?
- 08 **Pavel:** Preserve the ⁴ _____ as well. We need the original sequence, including anything recorded before the output stopped, rather than a summary written from memory.
- 09 **Grace:** The manager asked whether one failure means the whole population is unreliable. I can report this event, but we do not have the information for that broader conclusion.
- 10 **Pavel:** State the ⁵ _____ plainly. This record does not establish a representative population failure rate, and neither a reassuring nor an alarming estimate should be invented.

Conversation continues on the next page.

One interruption, several possible explanations

CONVERSATION / CONTINUED

- 11 **Grace:** We should also be clear about what happened beyond the sample. Loss of output is the mode, while the consequence depends on the function it serves.
- 12 **Pavel:** Correct. Describe the ⁶ _____ at the relevant level. Do not let the consequence, the observed mode, and the suspected cause become interchangeable labels.
- 13 **Grace:** Would it be useful to record the possible mode and causes in the structured review now, even while the evidence remains incomplete?
- 14 **Pavel:** Yes, update the ⁷ _____ where appropriate, with the uncertainty visible. Its entries should support investigation and control decisions, not give an unsupported explanation the appearance of formal proof.
- 15 **Grace:** We may need an immediate restriction while the investigation continues. I want to avoid calling that restriction a permanent fix in the status update.
- 16 **Pavel:** Call it ⁸ _____ if that is its actual purpose. The responsible team must define the measure and its limits; the name does not establish that recurrence is prevented.
- 17 **Grace:** Once evidence supports a cause, we can assess a response against it. Simply replacing something and observing a short successful run would not settle every question.
- 18 **Pavel:** A ⁹ _____ needs a cause-based rationale and appropriate verification. Keep the action proposal separate from evidence that it has removed the problem.

One interruption, several possible explanations / continued

- 19 **Grace:** I will revise the report to state the interruption, the unconfirmed connector explanation, the unchecked setup, and the next investigation review. The original result will stay in the record.
- 20 **Pavel:** That supports ¹⁰ _____. We can communicate progress honestly without choosing a cause early or allowing uncertainty to make the observed event disappear.

CHECK THE GAPS

1. failure mode / 2. hypothesis / 3. test setup / 4. event log / 5. residual uncertainty / 6. failure effect / 7. FMEA / 8. containment / 9. corrective action / 10. failure analysis

[Why these answers fit, page 125](#)

F Check accuracy and scope

One interruption, several possible explanations

Return to the case

During a planned 60-minute bench run, sample S7 stops producing an output at minute 46. Test engineer Grace and reliability engineer Pavel review the event. The failure has not been reproduced. The test setup has not been checked, and connector damage is only a hypothesis. The team has not established a population failure rate or a corrective action. Grace must preserve the result and test records while preventing a draft report from naming connector damage as the confirmed root cause.

Choose one answer per question. Use the case facts and keep any uncertainty or limits intact.

1. A later repeat run shows no interruption. What should happen to the original S7 result?

- A. Confirm connector damage because the event is intermittent.
- B. Declare the test setup fault-free because the repeat ran normally.
- C. Retain the minute-46 event and investigate why the observations differ; one repeat does not identify the cause.
- D. Delete it because the latest run replaces every earlier observation.

2. Which wording distinguishes containment from corrective action?

- A. Every temporary control removes the underlying mechanism.
- B. Exposure controls may begin while the cause-based action remains undecided.
- C. Containment proves that recurrence is impossible.
- D. A suspected cause is enough to declare permanent correction.

[Answers and explanations, page 126](#)

Listen for the distinction

Switch roles. Separate the observed mode, possible cause, setup checks, containment, and cause-based corrective action.

A plausible explanation is still a hypothesis

Technical teams often converge quickly on a familiar failure mechanism. Use language that invites testing of the explanation without dismissing experience. Keep the observed event, possible causes, immediate controls, and eventual corrective action in separate statements so confidence does not outrun evidence.

F Say it / transfer to a new case

Observed does not mean explained

Sample K4 loses its signal during a run. A damaged cable is suspected, but neither the cable nor the fixture has been checked. The original log is available.

Complete the four gaps. With a partner, read alternate roles, then switch. Studying alone, read both roles and pause before each response.

WORD AND PHRASE BANK

unresolved / log / mode / hypothesis

- 01 **Tester:** Loss of signal is the observed failure ¹ _____.
- 02 **Engineer:** Cable damage is still a ² _____.
- 03 **Tester:** We will preserve the original ³ _____.
- 04 **Engineer:** The root cause remains ⁴ _____.

CHECK THE GAPS

1. mode / 2. hypothesis / 3. log / 4. unresolved

[Why these answers fit, page 126](#)

F Say it / transfer to a new case / continued

Rebuild the exchange

Choose the missing response. Read the completed three-turn exchange aloud, changing roles on the second reading.

1. Rebuild the exchange from "One interruption, several possible explanations". Grace: "Would it be useful to record the possible mode and causes in the structured review now, even while the evidence remains incomplete?" Pavel: [missing response] Grace: "We may need an immediate restriction while the investigation continues. I want to avoid calling that restriction a permanent fix in the status update." Which response belongs in the gap?

- A.** Yes, update the FMEA where appropriate, with the uncertainty visible. Its entries should support investigation and control decisions, not give an unsupported explanation the appearance of formal proof.
- B.** State the residual uncertainty plainly. This record does not establish a representative population failure rate, and neither a reassuring nor an alarming estimate should be invented.
- C.** Call it containment if that is its actual purpose. The responsible team must define the measure and its limits; the name does not establish that recurrence is prevented.
- D.** Start with the failure mode. Loss of output is what we observed. Connector damage is a proposed explanation, and the wording needs to preserve that distinction.

[Answers and explanations, page 127](#)

A Read the situation

LESSON 04 / TESTING, VALIDATION, AND DATA INTERPRETATION

Report prototype results with their sample, conditions, criterion, and limits while distinguishing verification from broader validation.

Three passes do not mean every condition

Test lead Ben reviews a presentation with design engineer Amina. Three revision-B prototypes completed a two-hour bench test at 20 degrees Celsius. Their recorded maximum response times were 150, 160, and 175 milliseconds; the test criterion was no more than 200 milliseconds. All three met that criterion. The intended operating range extends from 10 to 40 degrees Celsius, but those other temperatures were not tested. The presentation currently claims that the design is proven for every operating condition.

People: Ben, Test lead; Amina, Design engineer.

Read the record

Choose one answer per question using the facts above.

1. Which result is supported?

- A. Every future unit will meet the criterion.
- B. The design has a proven lifetime reliability of 100%.
- C. All three prototypes met the stated bench criterion at 20 degrees Celsius.
- D. The complete operating range was tested.

2. Which value was the largest recorded maximum?

- A. 160 milliseconds
- B. 150 milliseconds
- C. 175 milliseconds
- D. 200 milliseconds

3. What remains untested in this case?

- A. The stated two-hour duration at 20 degrees Celsius
- B. The recorded response-time criterion at 20 degrees Celsius
- C. Performance at the other temperatures in the intended range
- D. All three revision-B prototypes

[Answers and explanations, page 128](#)

B Vocabulary in use

CORE TERMS

test protocol

The documented plan and procedure for a test.
approve the test protocol

test article

The identified item subjected to testing.
identify the test article

acceptance limit

The boundary used to judge a measured result.
compare with the acceptance limit

observed maximum

The largest value recorded in the stated observations.
report the observed maximum

instrument calibration

Establishing the relation between instrument indications and reference values.
check instrument calibration

test coverage

The requirements or conditions addressed by the performed tests.
identify gaps in test coverage

test condition

A specified circumstance under which a test is conducted.
record test conditions

sample size

The number of items or observations in a stated sample.
report the sample size

response time

The time between a defined input and response.
measure response time

measurement uncertainty

A quantified expression of doubt about a measured value.
evaluate measurement uncertainty

resolution

The smallest distinguishable change in a measurement or indication.
specify instrument resolution

boundary condition

A limiting input or operating condition used in analysis or testing.
examine boundary conditions

Say it in context

Stress the highlighted expression. Keep the surrounding words connected; pause at the end of the phrase.

test protocol TEST PROTOCOL

approve the test protocol

Keep the meaning precise: The documented plan and procedure for a test.

response time RESPONSE TIME

measure response time

Keep the meaning precise: The time between a defined input and response.

B Precision and professional shorthand

EXTEND YOUR RANGE

verification

Checking that specified requirements have been met.

complete requirement verification

representativeness

How well a sample or condition reflects the target use or population.

assess representativeness

confidence interval

A statistical interval constructed by a method with stated coverage properties.

report a confidence interval

population

The full set of items about which an inference is intended.

define the target population

test duration

The length of time a test runs.

state the test duration

test deviation

A recorded departure from the approved test procedure.

assess a test deviation

validation

Assessing whether a product meets intended-use needs.

plan intended-use validation

extrapolation

Extending a conclusion beyond the observed range.

avoid unsupported extrapolation

pass fraction

The proportion of tested items meeting a stated criterion.

calculate the observed pass fraction

censored observation

A lifetime observation ending before the event of interest occurs.

account for censored observations

reliability claim

A statement about performance without failure under stated conditions over time.

qualify a reliability claim

evidence boundary

The limit of what the available evidence establishes.

state the evidence boundary

Say it in context

Stress the highlighted expression. Keep the surrounding words connected; pause at the end of the phrase.

boundary condition BOUNDARY CONDITION

examine boundary conditions

Keep the meaning precise: A limiting input or operating condition used in analysis or testing.

confidence interval CONFIDENCE INTERVAL

report a confidence interval

Keep the meaning precise: A statistical interval constructed by a method with stated coverage properties.

C Phrases that move the work forward

Lead with the result

All three prototypes met the stated criterion.

Give the conditions

The test ran for two hours at 20 degrees Celsius.

Report the largest value

The largest recorded maximum was 175 milliseconds.

Bound the percentage

The observed pass fraction was three out of three.

Identify missing coverage

The other intended temperatures were not tested.

Qualify the headline

Replace proven everywhere with the result actually demonstrated.

Keep records connected

Link the result to its test article and protocol.

Preserve positive progress

The test supports this criterion under these conditions.

Name the configuration

These results apply to revision B.

State the criterion

The response-time limit was 200 milliseconds.

Preserve the unit

These values are in milliseconds, not seconds.

Avoid population overclaim

That is not proof that every production unit will pass.

Separate purposes

This bench check is not complete intended-use validation.

Ask about uncertainty

Where is the measurement-uncertainty assessment?

Avoid invented confidence

The supplied data do not provide a stated confidence level.

Close the report

State the result, conditions, limitation, and next evidence need.

Precision in real exchanges

Purpose: State the criterion

Useful wording: The response-time limit was 200 milliseconds.

Purpose: Report the largest value

Useful wording: The largest recorded maximum was 175 milliseconds.

D Choose the response that fits

Choose one response for each situation. Preserve the facts, the decision boundary, and the purpose of the exchange.

1. Which presentation headline is most accurate?

- A.** Revision B is proven across all operating conditions.
- B.** Every manufactured unit will respond within 175 milliseconds.
- C.** Two hours establish the complete service life.
- D.** Three revision-B prototypes met the response-time criterion in the stated bench test.

2. What does the observed 100% pass fraction mean?

- A.** All three tested items met this criterion in this test.
- B.** The true population failure probability is known to be zero.
- C.** The entire 10-to-40-degree range has been covered.
- D.** No additional evidence could change the assessment.

3. A colleague needs the term for this meaning: The number of items or observations in a stated sample. Which term fits?

- A.** test duration
- B.** sample size
- C.** instrument calibration
- D.** representativeness

D Choose the response that fits / continued

4. Rebuild the exchange from "Three passes do not mean every condition". Amina: "The recorded maximum response times were one hundred fifty, one hundred sixty, and one hundred seventy-five milliseconds. The criterion allowed up to two hundred milliseconds." Ben: [missing response] Amina: "I will write three out of three met the criterion. That is clearer than a large one-hundred-percent headline with the sample size hidden below it." Which response belongs in the gap?

- A.** Then that would be unsupported extrapolation. Do not substitute a plausible expectation for evidence, especially when the presentation may guide a release or customer commitment.
- B.** Exactly. Keep the sample size visible. A percentage can sound much more comprehensive than the underlying evidence when the number of tested items is omitted.
- C.** That is a test coverage limitation. State it directly; do not imply the untested temperatures failed, but do not label them verified either.
- D.** Then the largest observed maximum was one hundred seventy-five. That is twenty-five milliseconds below the criterion, but it is not a universal product limit.

[Answers and explanations, page 128](#)

One useful distinction

Three out of three is a 100% observed pass fraction for this test. It is not proof of perfect reliability in the population or across the operating range. The largest recorded maximum, 175 ms, is 25 ms below the stated 200 ms criterion.

E Conversation

Three passes do not mean every condition

Three passes do not mean every condition

Complete the numbered gaps. Use each bank entry once; some entries contain several words.

WORD AND PHRASE BANK

sample size / extrapolation / validation / observed maximum / evidence boundary /
verification / test conditions / reliability claim / test coverage / pass fraction

- 01 **Amina:** The presentation says the design is proven for every operating condition. All three prototypes passed, so I thought that was a concise way to report the positive result.
- 02 **Ben:** We can report the ¹ _____, but the headline goes further. Three out of three describes the tested sample, not every unit or every condition in the operating range.
- 03 **Amina:** Let us put the actual conditions beside the result. These were revision-B prototypes, tested for two hours at twenty degrees Celsius under the bench procedure.
- 04 **Ben:** Those ² _____ are essential. Readers should not have to search an appendix to discover that the rest of the intended temperature range was not tested.
- 05 **Amina:** The recorded maximum response times were one hundred fifty, one hundred sixty, and one hundred seventy-five milliseconds. The criterion allowed up to two hundred milliseconds.
- 06 **Ben:** Then the largest ³ _____ was one hundred seventy-five. That is twenty-five milliseconds below the criterion, but it is not a universal product limit.
- 07 **Amina:** I will write three out of three met the criterion. That is clearer than a large one-hundred-percent headline with the sample size hidden below it.
- 08 **Ben:** Exactly. Keep the ⁴ _____ visible. A percentage can sound much more comprehensive than the underlying evidence when the number of tested items is omitted.
- 09 **Amina:** The intended operating range is ten to forty degrees. Since we tested only twenty, the other temperatures remain a gap rather than a demonstrated pass.
- 10 **Ben:** That is a ⁵ _____ limitation. State it directly; do not imply the untested temperatures failed, but do not label them verified either.

Conversation continues on the next page.

Three passes do not mean every condition

CONVERSATION / CONTINUED

- 11 **Amina:** Would it help to distinguish checking this performance criterion from confirming that the product works adequately for its intended users and operating tasks?
- 12 **Ben:** Yes. This supports ⁶ _____ of the stated criterion under the recorded conditions. Broader intended-use questions need their own evidence and cannot be settled by relabeling this test.
- 13 **Amina:** The slide also calls the product fully validated. We have not supplied evidence for the complete use context, so that phrase creates a second overclaim.
- 14 **Ben:** Remove the unsupported ⁷ _____ claim. We can explain what has been demonstrated and which intended-use evidence remains outstanding without making the result sound like a failure.
- 15 **Amina:** What should I say if someone asks about ten and forty degrees? We have no supporting model or test at those temperatures in this package.
- 16 **Ben:** Then that would be unsupported ⁸ _____. Do not substitute a plausible expectation for evidence, especially when the presentation may guide a release or customer commitment.
- 17 **Amina:** I will also avoid adding a confidence percentage. The supplied records do not include a statistical sampling plan, uncertainty budget, or lifetime analysis.
- 18 **Ben:** Correct. A ⁹ _____ needs its own defined basis. The fact that no failure occurred in these runs does not establish a zero population failure probability.
- 19 **Amina:** The revised headline will say three revision-B prototypes met the response-time criterion during a two-hour bench test at twenty degrees. The next sentence will identify the untested temperatures.
- 20 **Ben:** That states the ¹⁰ _____ clearly. We retain the positive result and give the review team enough context to decide what additional evidence is needed.

CHECK THE GAPS

1. pass fraction / 2. test conditions / 3. observed maximum / 4. sample size / 5. test coverage / 6. verification / 7. validation / 8. extrapolation / 9. reliability claim / 10. evidence boundary

[Why these answers fit, page 129](#)

F Check accuracy and scope

Three passes do not mean every condition

Return to the case

Test lead Ben reviews a presentation with design engineer Amina. Three revision-B prototypes completed a two-hour bench test at 20 degrees Celsius. Their recorded maximum response times were 150, 160, and 175 milliseconds; the test criterion was no more than 200 milliseconds. All three met that criterion. The intended operating range extends from 10 to 40 degrees Celsius, but those other temperatures were not tested. The presentation currently claims that the design is proven for every operating condition.

Choose one answer per question. Use the case facts and keep any uncertainty or limits intact.

1. The largest recorded maximum is 175 ms against a 200 ms limit. Which statement is precise?

- A.** The observed gap to the limit is 25 ms; no supplied uncertainty budget establishes a guaranteed margin for all units.
- B.** The product is guaranteed to remain 25 ms below the limit at every temperature.
- C.** The limit should be revised to 175 ms because that is the largest observed value.
- D.** The gap is 25 seconds, proving the five-year service target.

2. Which limitation is specific and useful?

- A.** The design necessarily fails at every untested temperature.
- B.** All intended-use requirements are automatically satisfied.
- C.** Performance at the other intended temperatures was not tested.
- D.** Nothing at all can be learned from the test.

[Answers and explanations, page 131](#)

Listen for the distinction

Switch roles. Bound the 175 ms observed maximum and 100% sample pass fraction without extending them across 10-40 degrees Celsius.

Lead with the result and its boundary

A qualified result can still be useful and positive. State what passed before explaining what was not tested. This avoids both overclaiming and burying genuine progress under vague caution. List the exact evidence gap that limits the wider claim.

F Say it / transfer to a new case

Four passes, one tested temperature

Four prototypes pass a three-hour bench test at 25 degrees Celsius. The intended range also includes lower and higher temperatures, which were not tested. No population reliability estimate is supplied.

Complete the four gaps. With a partner, read alternate roles, then switch. Studying alone, read both roles and pause before each response.

WORD AND PHRASE BANK

untested / hours / reliability / four

- 01 **Engineer:** The tested sample size was ¹ _____.
- 02 **Reviewer:** The duration was three ² _____.
- 03 **Engineer:** The other temperatures remain ³ _____.
- 04 **Reviewer:** The result does not establish population ⁴ _____.

CHECK THE GAPS

1. four / 2. hours / 3. untested / 4. reliability

[Why these answers fit, page 131](#)

F Say it / transfer to a new case / continued

Rebuild the exchange

Choose the missing response. Read the completed three-turn exchange aloud, changing roles on the second reading.

1. Rebuild the exchange from "Three passes do not mean every condition". Amina: "The slide also calls the product fully validated. We have not supplied evidence for the complete use context, so that phrase creates a second overclaim." Ben: [missing response] Amina: "What should I say if someone asks about ten and forty degrees? We have no supporting model or test at those temperatures in this package." Which response belongs in the gap?

- A.** Those test conditions are essential. Readers should not have to search an appendix to discover that the rest of the intended temperature range was not tested.
- B.** Correct. A reliability claim needs its own defined basis. The fact that no failure occurred in these runs does not establish a zero population failure probability.
- C.** Exactly. Keep the sample size visible. A percentage can sound much more comprehensive than the underlying evidence when the number of tested items is omitted.
- D.** Remove the unsupported validation claim. We can explain what has been demonstrated and which intended-use evidence remains outstanding without making the result sound like a failure.

[Answers and explanations, page 132](#)

Review 2 / Meaning and context

Use language from the lessons you have completed. Choose one answer per question.

Case file

Revisit "Failure Modes and Reliability" and "Testing, Validation, and Data Interpretation". Choose precise terminology, then reconstruct the missing responses using both neighboring turns. The final two questions also revisit earlier conversations.

1. A colleague needs the term for this meaning: The physical or other process producing a failure. Which term fits?

- A. reproducibility
- B. failure mechanism
- C. FMEA
- D. diagnostic evidence

2. A colleague needs the term for this meaning: A quantified expression of doubt about a measured value. Which term fits?

- A. population
- B. test protocol
- C. verification
- D. measurement uncertainty

3. Rebuild the exchange from "The drawing fits; the evidence is missing". Ahmed: "I can own the analysis. I will identify the confirmed supplier revision, state the tolerance assumptions, and present the resulting minimum against R-14." Clara: [missing response] Ahmed: "Could the chair record conditional approval and allow the release team to continue? I want to avoid delaying work that does not depend on this interface." Which response belongs in the gap?

- A. Agreed. Identify the release authority and let that role decide on the recorded basis. My review comment should not be mistaken for unilateral approval or rejection.
- B. That provides the intended closure evidence. The reviewer still needs to assess the result; attaching a file is not itself the same as resolving the concern.
- C. Exactly. Make it a review action with an owner and a review point. The task is narrow enough to complete without reopening unrelated parts of the design.
- D. Keep that open item visible in the action list. A meeting ending or an owner accepting the task must not make its status appear complete.

Review 2 / Meaning and context / continued

4. Rebuild the exchange from "Three passes do not mean every condition". Amina: "I will also avoid adding a confidence percentage. The supplied records do not include a statistical sampling plan, uncertainty budget, or lifetime analysis." Ben: [missing response] Amina: "The revised headline will say three revision-B prototypes met the response-time criterion during a two-hour bench test at twenty degrees. The next sentence will identify the untested temperatures." Which response belongs in the gap?

- A.** Those test conditions are essential. Readers should not have to search an appendix to discover that the rest of the intended temperature range was not tested.
- B.** Correct. A reliability claim needs its own defined basis. The fact that no failure occurred in these runs does not establish a zero population failure probability.
- C.** Remove the unsupported validation claim. We can explain what has been demonstrated and which intended-use evidence remains outstanding without making the result sound like a failure.
- D.** Exactly. Keep the sample size visible. A percentage can sound much more comprehensive than the underlying evidence when the number of tested items is omitted.

[Answers and explanations, page 155](#)

A Read the situation

LESSON 05 / MANUFACTURABILITY AND COST ENGINEERING

Compare design costs on the same volume and cost basis while keeping manufacturability and approval separate from arithmetic.

Cheaper material, more expensive assembly

Design engineer Tessa and manufacturing engineer Arun compare two proposed housings for 3,000 acceptable units. Option A has material cost of \$8 and assembly cost of \$6 per unit, plus \$1,000 one-time tooling. Option B has material cost of \$10 and assembly cost of \$2 per unit, plus \$5,000 tooling. These are the only cost elements in the comparison, with no scrap assumed. Technical suitability, supplier capacity, and approval are unresolved. A slide nevertheless recommends A solely because its material is cheaper.

People: Tessa, Design engineer; Arun, Manufacturing engineer.

Read the record

Choose one answer per question using the facts above.

1. What is the recurring material-plus-assembly cost of A?

- A.** \$8 per unit
- B.** \$6 per unit
- C.** \$12 per unit
- D.** \$14 per unit

2. What is the total stated cost of B for 3,000 units?

- A.** \$36,000
- B.** \$35,000
- C.** \$47,000
- D.** \$41,000

3. What remains unresolved after the calculation?

- A.** The supplied tooling amount for A
- B.** The supplied material cost for B
- C.** The stated comparison quantity
- D.** Technical suitability, capacity, and approval

[Answers and explanations, page 133](#)

B Vocabulary in use

CORE TERMS

manufacturability

How readily a design can be produced by the intended process.

assess manufacturability

design for manufacture

Design choices suited to the intended manufacturing process, abbreviated DFM.

review design for manufacture

material cost

The stated cost of materials used in a unit.

estimate material cost

recurring cost

A cost incurred repeatedly as units are produced.

compare recurring cost

tooling investment

Expenditure on equipment or tools needed for production.

justify tooling investment

cost model

A structured calculation connecting cost assumptions and totals.

review the cost model

design for assembly

Design choices that simplify or improve assembly, abbreviated DFA.

apply design for assembly

bill of materials

The structured list of parts and materials in a product, abbreviated BOM.

compare the bill of materials

assembly cost

The cost assigned to assembling a unit.

reduce assembly cost

nonrecurring cost

A cost incurred once for the defined program or setup.

identify nonrecurring cost

unit cost

Cost per unit on a stated inclusion and volume basis.

calculate unit cost

cost driver

A factor that materially changes cost.

identify the cost driver

Say it in context

Stress the highlighted expression. Keep the surrounding words connected; pause at the end of the phrase.

manufacturability **MANUFACTURABILITY**

assess manufacturability

Keep the meaning precise: How readily a design can be produced by the intended process.

assembly cost **ASSEMBLY COST**

reduce assembly cost

Keep the meaning precise: The cost assigned to assembling a unit.

B Precision and professional shorthand

EXTEND YOUR RANGE

production volume

The number of units made in a stated period or program.

state production volume

incremental cost

The change in cost between specified alternatives.

compare incremental cost

process capability

The ability of a stable process to meet specified limits.

assess process capability

takt time

Available production time divided by required customer demand.

compare cycle time with takt time

yield assumption

The assumed proportion of production meeting a defined criterion.

challenge the yield assumption

part consolidation

Combining functions to reduce the number of separate parts.

evaluate part consolidation

break-even volume

The quantity at which compared total costs are equal.

calculate break-even volume

cost trade-off

An exchange between cost categories or other design outcomes.

explain the cost trade-off

cycle time

Time taken for one defined production cycle.

measure cycle time

scrap allowance

A stated cost or quantity provision for unusable production.

include a scrap allowance

tolerance relaxation

Widening a dimensional limit subject to design requirements.

assess tolerance relaxation

make-or-buy decision

Choosing between internal production and external supply.

support a make-or-buy decision

Say it in context

Stress the highlighted expression. Keep the surrounding words connected; pause at the end of the phrase.

cost driver COST DRIVER

identify the cost driver

Keep the meaning precise: A factor that materially changes cost.

process capability PROCESS CAPABILITY

assess process capability

Keep the meaning precise: The ability of a stable process to meet specified limits.

Phrases that move the work forward

Set the comparison

Use the same 3,000-unit quantity for both options.

Challenge the narrow claim

Lower material cost does not necessarily mean lower total cost.

State the alternative

B has \$12 of recurring cost per unit.

Give the total

The stated totals are \$43,000 for A and \$41,000 for B.

Identify the crossover

The total costs are equal at 2,000 units.

Expose the assumption

No scrap is assumed in these figures.

Ask about capacity

Can the proposed process deliver the required volume?

Check the denominator

Which production quantity supports that unit-cost figure?

Name the categories

Include material, assembly, and one-time tooling.

Add recurring costs

A has \$14 of material and assembly cost per unit.

Keep tooling separate

B requires \$4,000 more upfront tooling.

Explain the difference

B is \$2,000 lower at this volume.

Qualify the model

The comparison includes only the listed cost elements.

Protect technical criteria

A cost advantage does not establish manufacturability.

Avoid premature selection

B leads on this cost basis, pending the other reviews.

Close the recommendation

Separate the cost result from the design approval decision.

Precision in real exchanges

Purpose: Add recurring costs

Useful wording: A has \$14 of material and assembly cost per unit.

Purpose: State the alternative

Useful wording: B has \$12 of recurring cost per unit.

D Choose the response that fits

Choose one response for each situation. Preserve the facts, the decision boundary, and the purpose of the exchange.

1. Which recommendation is supported at 3,000 units?

- A.** A and B have equal totals at every quantity.
- B.** B has the lower stated cost, subject to unresolved technical and capacity reviews.
- C.** A must be chosen because its material costs less.
- D.** B is technically approved because its calculated total is lower.

2. At which volume are the stated totals equal?

- A.** 3,000 units
- B.** 4,000 units
- C.** 2,000 units
- D.** 500 units

3. A colleague needs the term for this meaning: The structured list of parts and materials in a product, abbreviated BOM. Which term fits?

- A.** tooling investment
- B.** bill of materials
- C.** incremental cost
- D.** yield assumption

D Choose the response that fits / continued

4. Rebuild the exchange from "Cheaper material, more expensive assembly". Tessa: "Two dollars times three thousand gives six thousand saved. Should I put six thousand as the overall saving on the slide?" Arun: [missing response] Tessa: "Let me check the totals: A is forty-two thousand plus one thousand, and B is thirty-six thousand plus five thousand. Forty-three versus forty-one thousand." Which response belongs in the gap?

- A.** Then we need the full stated cost model before recommending an option. Use material, assembly, and one-time tooling for three thousand acceptable units, with no scrap.
- B.** That is the break-even volume. At two thousand units, A is twenty-eight thousand plus one thousand; B is twenty-four thousand plus five thousand. Both total twenty-nine thousand.
- C.** Also label each unit cost figure as recurring-only or tooling-inclusive. That will stop the next reader comparing twelve dollars with a total-cost figure from another volume.
- D.** Not yet. B's tooling investment is five thousand against A's one thousand. Subtract that additional four thousand from the recurring saving; the overall difference is two thousand.

[Answers and explanations, page 133](#)

One useful distinction

A costs \$43,000 and B costs \$41,000 for 3,000 units on the stated basis. B saves \$2 per unit in recurring cost but requires \$4,000 more tooling. Their totals are equal at 2,000 units. These arithmetic results do not establish technical suitability.

E Conversation

Cheaper material, more expensive assembly

Cheaper material, more expensive assembly

Complete the numbered gaps. Use each bank entry once; some entries contain several words.

WORD AND PHRASE BANK

cost model / break-even volume / yield assumption / tooling investment /
production volume / recurring cost / cost trade-off / manufacturability / unit cost /
process capability

- 01 **Tessa:** The slide recommends A because its material costs eight dollars per unit instead of ten. I have not included assembly or tooling in that recommendation yet.
- 02 **Arun:** Then we need the full stated ¹ _____ before recommending an option. Use material, assembly, and one-time tooling for three thousand acceptable units, with no scrap.
- 03 **Tessa:** A is eight plus six, so fourteen per unit. B is ten plus two, so twelve. The cheaper material does not give A the cheaper repeated work.
- 04 **Arun:** Correct. B saves two dollars in ² _____ per unit. That comparison includes assembly but not either option's one-time production equipment expense.
- 05 **Tessa:** Two dollars times three thousand gives six thousand saved. Should I put six thousand as the overall saving on the slide?
- 06 **Arun:** Not yet. B's ³ _____ is five thousand against A's one thousand. Subtract that additional four thousand from the recurring saving; the overall difference is two thousand.

E Conversation / continued

- 07 **Tessa:** Let me check the totals: A is forty-two thousand plus one thousand, and B is thirty-six thousand plus five thousand. Forty-three versus forty-one thousand.
- 08 **Arun:** Yes, at the stated ⁴ _____ of three thousand. Attach the quantity to the conclusion; a smaller order may not recover B's extra upfront expense.
- 09 **Tessa:** The extra tooling is four thousand and the recurring difference is two per unit. Dividing gives two thousand units. Is that where the costs are equal?
- 10 **Arun:** That is the ⁵ _____. At two thousand units, A is twenty-eight thousand plus one thousand; B is twenty-four thousand plus five thousand. Both total twenty-nine thousand.

Conversation continues on the next page.

Cheaper material, more expensive assembly

CONVERSATION / CONTINUED

- 11 **Tessa:** At only one thousand units, A becomes fifteen thousand and B seventeen thousand. So saying B is always cheaper would also be wrong.
- 12 **Arun:** Exactly. State the ⁶ _____: higher tooling buys lower recurring expense. The comparison changes with quantity even before we examine any unlisted costs.
- 13 **Tessa:** Can we recommend buying B now that it wins this calculation? Its assembly estimate is attractive, but technical suitability has not been reviewed.
- 14 **Arun:** No. Its ⁷ _____ is still unresolved. The cost sheet does not show that the proposed process can produce a housing meeting the design requirements.
- 15 **Tessa:** I also need the supplier's capacity confirmation. Having enough machines available would answer volume, but not necessarily whether the parts meet dimensional limits.
- 16 **Arun:** Right. Assess ⁸ _____ separately from capacity. Consistent conformance under a stable process and available production quantity are different questions.
- 17 **Tessa:** We assumed every produced unit is acceptable. I will state that clearly, rather than present the model as though we measured the supplier's losses.
- 18 **Arun:** Keep that ⁹ _____ beside the totals. Scrap or rework could change acceptable-unit cost; the present comparison includes only the three listed cost categories.
- 19 **Tessa:** I will revise the slide: B is two thousand lower at three thousand units on the stated basis, pending suitability, capacity, and approval. No purchase is authorized.
- 20 **Arun:** Also label each ¹⁰ _____ figure as recurring-only or tooling-inclusive. That will stop the next reader comparing twelve dollars with a total-cost figure from another volume.

CHECK THE GAPS

1. cost model / 2. recurring cost / 3. tooling investment / 4. production volume / 5. break-even volume / 6. cost trade-off / 7. manufacturability / 8. process capability / 9. yield assumption / 10. unit cost

[Why these answers fit, page 134](#)

F Check accuracy and scope

Cheaper material, more expensive assembly

Return to the case

Design engineer Tessa and manufacturing engineer Arun compare two proposed housings for 3,000 acceptable units. Option A has material cost of \$8 and assembly cost of \$6 per unit, plus \$1,000 one-time tooling. Option B has material cost of \$10 and assembly cost of \$2 per unit, plus \$5,000 tooling. These are the only cost elements in the comparison, with no scrap assumed. Technical suitability, supplier capacity, and approval are unresolved. A slide nevertheless recommends A solely because its material is cheaper.

Choose one answer per question. Use the case facts and keep any uncertainty or limits intact.

1. B saves \$2 per unit for 3,000 units. Why is the stated total saving \$2,000 rather than \$6,000?

- A. The \$6,000 recurring saving is offset by B's \$4,000 additional tooling.
- B. B's \$5,000 tooling should be deducted twice.
- C. A's tooling is recurring and must be multiplied by 3,000.
- D. The two-dollar difference applies only to the first 1,000 units.

2. Why should the model state no scrap?

- A. Scrap can never affect unit cost.
- B. Different production yields could change the cost comparison.
- C. The assumption proves every real unit will be acceptable.
- D. Tooling cost disappears when scrap is excluded.

[Answers and explanations, page 136](#)

Listen for the distinction

Switch roles for turns 11-20. Separate cost, capacity, process capability, and design approval.

Compare like with like

An engineer can challenge a cost recommendation without challenging the cost-saving objective. Put both alternatives on the same quantity, cost categories, and assumptions. Then distinguish the numerical result from the separate evidence needed to select and release a design.

F Say it / transfer to a new case

When the quantity changes the answer

Option C costs \$9 per unit plus \$2,000 tooling. Option D costs \$7 per unit plus \$6,000 tooling. Only these costs apply, with no scrap. Compare 1,000 units.

Complete the four gaps. With a partner, read alternate roles, then switch. Studying alone, read both roles and pause before each response.

WORD AND PHRASE BANK

11000 / C / 13000 / 2000

- 01 **Engineer:** C totals ¹ _____ dollars.
- 02 **Reviewer:** D totals ² _____ dollars.
- 03 **Engineer:** At this quantity, the lower-cost option is ³ _____.
- 04 **Reviewer:** Equal totals occur at ⁴ _____ units.

CHECK THE GAPS

1. 11000 / 2. 13000 / 3. C / 4. 2000

[Why these answers fit, page 136](#)

Rebuild the exchange

Choose the missing response. Read the completed three-turn exchange aloud, changing roles on the second reading.

1. Rebuild the exchange from "Cheaper material, more expensive assembly". Tessa: "Can we recommend buying B now that it wins this calculation? Its assembly estimate is attractive, but technical suitability has not been reviewed." Arun: [missing response] Tessa: "I also need the supplier's capacity confirmation. Having enough machines available would answer volume, but not necessarily whether the parts meet dimensional limits." Which response belongs in the gap?

- A.** Keep that yield assumption beside the totals. Scrap or rework could change acceptable-unit cost; the present comparison includes only the three listed cost categories.
- B.** Yes, at the stated production volume of three thousand. Attach the quantity to the conclusion; a smaller order may not recover B's extra upfront expense.
- C.** Exactly. State the cost trade-off: higher tooling buys lower recurring expense. The comparison changes with quantity even before we examine any unlisted costs.
- D.** No. Its manufacturability is still unresolved. The cost sheet does not show that the proposed process can produce a housing meeting the design requirements.

[Answers and explanations, page 137](#)

A Read the situation

LESSON 06 / SAFETY FACTORS AND COMPLIANCE

Question a compliance claim by identifying the applicable requirement, analysis basis, evidence scope, and decision authority.

A ratio is not a compliance decision

Engineer Rosa and assurance lead Malik review a fictional design note labeled compliant. A preliminary static model reports a safety factor of 2.0 using its stated capacity-to-demand convention. The applicable requirement, acceptance threshold, and reviewer are not identified. Fatigue and dynamic loading are outside the model. No release approval or formal conformity assessment is recorded. Rosa must correct the note without claiming the design is either safe or unsafe from the ratio alone.

People: Rosa, Design engineer; Malik, Assurance lead.

Read the record

Choose one answer per question using the facts above.

1. What does 2.0 describe in the note?

- A. A preliminary static-model ratio under its stated convention
- B. Complete product conformity
- C. A demonstrated fatigue life
- D. An authorized release decision

2. Which behavior is outside the model's assessment?

- A. The model's stated capacity-to-demand convention
- B. The numerical result of 2.0
- C. Fatigue and dynamic-loading effects
- D. Every possible static input

3. What is missing from the compliance claim?

- A. The applicable requirement and acceptance threshold
- B. A preliminary ratio of 2.0
- C. A statement that the model is static
- D. A statement that release approval is absent

[Answers and explanations, page 138](#)

B Vocabulary in use

CORE TERMS

factor of safety

A defined ratio comparing capacity and demand on a stated basis.

state the factor of safety

design load

A load case specified for design assessment.

define the design load

static analysis

Analysis of conditions treated without significant time-dependent dynamics.

review static analysis

fatigue

Progressive damage associated with repeated loading.

evaluate fatigue

yield limit

A boundary associated with the onset of specified permanent deformation.

identify the yield limit

failure criterion

The condition used to define failure in an analysis.

specify the failure criterion

allowable

A permitted value established by the applicable design basis.

identify the allowable

load case

A defined combination of actions considered in an analysis.

assess the load case

dynamic loading

Loading whose time variation requires dynamic effects to be considered.

assess dynamic loading

ultimate capacity

Capacity associated with a defined ultimate failure limit.

state ultimate capacity

buckling

Instability involving a change in structural form under loading.

assess buckling

load combination

A defined set of loads considered together.

document the load combination

Say it in context

Stress the highlighted expression. Keep the surrounding words connected; pause at the end of the phrase.

factor of safety FACTOR OF SAFETY

state the factor of safety

Keep the meaning precise: A defined ratio comparing capacity and demand on a stated basis.

dynamic loading DYNAMIC LOADING

assess dynamic loading

Keep the meaning precise: Loading whose time variation requires dynamic effects to be considered.

B Precision and professional shorthand

EXTEND YOUR RANGE

model validity

The degree to which a model is suitable for its intended assessment.

assess model validity

applicable requirement

A requirement that governs the specific product or situation.

identify applicable requirements

conformity assessment

Evaluation of whether specified requirements are fulfilled.

identify the conformity assessment route

standard edition

The identified version of a published standard.

confirm the standard edition

independent review

Review by a suitably separate qualified reviewer.

arrange independent review

deviation approval

Authorized acceptance of a defined departure where permitted.

record deviation approval

analysis limitation

A condition or behavior not adequately addressed by an analysis.

state analysis limitations

compliance matrix

A record linking requirements to evidence and status.

maintain a compliance matrix

normative reference

A referenced document needed to apply a specification's requirements.

check normative references

evidence package

The records supporting a technical or compliance conclusion.

assemble the evidence package

authorized sign-off

Recorded approval by a person with the relevant authority.

obtain authorized sign-off

release restriction

A stated limit on what may proceed under a decision.

communicate release restrictions

Say it in context

Stress the highlighted expression. Keep the surrounding words connected; pause at the end of the phrase.

load combination LOAD COMBINATION

document the load combination

Keep the meaning precise: A defined set of loads considered together.

conformity assessment CONFORMITY ASSESSMENT

identify the conformity assessment route

Keep the meaning precise: Evaluation of whether specified requirements are fulfilled.

Phrases that move the work forward

Ask for the basis

Compliant with which applicable requirement?

Name the convention

The reported factor uses the stated capacity-to-demand ratio.

Ask for the criterion

Which failure criterion and acceptance threshold apply?

Avoid a universal rule

A factor of 2.0 is not a universal acceptance threshold.

Request traceability

Link each requirement to its supporting evidence.

Keep status precise

The compliance conclusion is not yet established.

Ask about review

Who is qualified and authorized to review this assessment?

Preserve restrictions

State what cannot proceed while the item remains open.

Identify the version

Which standard edition does the assessment use?

Limit the result

This is a preliminary static-model result.

Expose excluded behavior

Fatigue and dynamic loading are outside this model.

Separate analysis from approval

A calculated result is not authorized sign-off.

Check model scope

Does the model represent the load cases being claimed?

Avoid unsupported alarm

The missing record does not itself prove physical failure.

Clarify a departure

Any permitted deviation needs the required approval.

Close the note

Report the result, limits, missing basis, and pending decision.

Precision in real exchanges

Purpose: Limit the result

Useful wording: This is a preliminary static-model result.

Purpose: Ask for the criterion

Useful wording: Which failure criterion and acceptance threshold apply?

D Choose the response that fits

Choose one response for each situation. Preserve the facts, the decision boundary, and the purpose of the exchange.

1. Which replacement note is justified?

- A.** The product is fully compliant because 2.0 exceeds one.
- B.** The product is proven unsafe because no reviewer is listed.
- C.** Fatigue is acceptable because the static result is favorable.
- D.** The preliminary static model reports 2.0; applicable acceptance requirements and review remain unresolved.

2. Why is the applicable requirement necessary?

- A.** It establishes what must be assessed and the acceptance basis.
- B.** It changes every preliminary result into automatic approval.
- C.** It removes the need to identify model limitations.
- D.** It guarantees that all standards use the same factor convention.

3. A colleague needs the term for this meaning: A defined combination of actions considered in an analysis. Which term fits?

- A.** applicable requirement
- B.** load case
- C.** independent review
- D.** yield limit

D Choose the response that fits / continued

4. Rebuild the exchange from "A ratio is not a compliance decision". Rosa: "I will name the failure condition beside the ratio. Which inputs and assumptions must the reviewer see to understand what this particular calculation covers?" Malik: [missing response] Rosa: "Fatigue and dynamic loading were excluded. I will state that directly instead of allowing the static result to stand in for those separate questions." Which response belongs in the gap?

- A.** Correct. The conformity assessment route needs confirmation for this product and jurisdiction. This discussion cannot replace the responsible specialists or the required process.
- B.** Yes, including the relevant standard edition where a standard applies. Do not list an impressive collection of references without establishing their relevance and authority.
- C.** Then describe the factor of safety on that limited basis. Two is the reported preliminary value, not a universal rule that establishes compliance for every design.
- D.** Exactly. Name the failure criterion and the relevant inputs. A ratio without that context can sound precise while leaving its actual technical meaning unclear.

[Answers and explanations, page 138](#)

One useful distinction

A factor of safety is meaningful only with its stated convention, failure criterion, inputs, and load cases. A value of 2.0 in one preliminary static model is not a universal safety threshold and cannot establish fatigue performance or complete conformity.

E Conversation

A ratio is not a compliance decision

A ratio is not a compliance decision

Complete the numbered gaps. Use each bank entry once; some entries contain several words.

WORD AND PHRASE BANK

failure criterion / evidence package / analysis limitations / compliance matrix /
authorized sign-off / conformity assessment / model validity / factor of safety /
standard edition / applicable requirement

- 01 **Rosa:** The note says compliant, and the preliminary analysis reports a factor of two. Before I circulate it, I want to check whether that label is justified.
- 02 **Malik:** Start with the ¹ _____. Compliant with what, and on which acceptance basis? A favorable number does not identify the requirement or the scope of the conclusion.
- 03 **Rosa:** The model uses its stated capacity-to-demand convention. It is a static assessment, but the note does not identify the required threshold or who reviewed the result.
- 04 **Malik:** Then describe the ² _____ on that limited basis. Two is the reported preliminary value, not a universal rule that establishes compliance for every design.
- 05 **Rosa:** I will name the failure condition beside the ratio. Which inputs and assumptions must the reviewer see to understand what this particular calculation covers?
- 06 **Malik:** Exactly. Name the ³ _____ and the relevant inputs. A ratio without that context can sound precise while leaving its actual technical meaning unclear.
- 07 **Rosa:** Fatigue and dynamic loading were excluded. I will state that directly instead of allowing the static result to stand in for those separate questions.
- 08 **Malik:** Those are important ⁴ _____. The reader needs them beside the result, especially if the note might be used to support a broader design or release decision.
- 09 **Rosa:** Could I say the static result is encouraging, provided I avoid saying it proves the product safe? I do not want to hide useful work either.
- 10 **Malik:** Report the result, but keep ⁵ _____ and review status explicit. The model must be suitable for the claim, and the acceptance basis still needs to be identified.

Conversation continues on the next page.

A ratio is not a compliance decision

CONVERSATION / CONTINUED

- 11 **Rosa:** I will check the contract requirements too. Can we identify the applicable documents and versions before the note lists standards that may not govern this product?
- 12 **Malik:** Yes, including the relevant ⁶ _____. Where a standard applies. Do not list an impressive collection of references without establishing their relevance and authority.
- 13 **Rosa:** I can organize the record so each applicable requirement points to the analysis or test evidence and shows whether assessment is complete, open, or awaiting review.
- 14 **Malik:** That is the purpose of a ⁷ _____. It should expose the missing links rather than turn a single favorable calculation into a blanket green status.
- 15 **Rosa:** We also have no formal conformity assessment recorded. I should not write as though assembling the internal note has completed whatever external or internal route applies.
- 16 **Malik:** Correct. The ⁸ _____ route needs confirmation for this product and jurisdiction. This discussion cannot replace the responsible specialists or the required process.
- 17 **Rosa:** Then the revised note can preserve the factor of two, identify the model exclusions, and say that the compliance conclusion remains unestablished pending the required review.
- 18 **Malik:** Also distinguish that from ⁹ _____. No release approval is recorded, and a technical result must not silently become permission to proceed.
- 19 **Rosa:** I will keep the current restrictions visible and identify who will confirm the requirements and review the evidence. I will not call the design either safe or unsafe from this ratio alone.
- 20 **Malik:** Good. The ¹⁰ _____ should let a qualified decision maker see what is supported and what is missing. That is more useful than an unsupported compliance label.

CHECK THE GAPS

1. applicable requirement / 2. factor of safety / 3. failure criterion / 4. analysis limitations / 5. model validity / 6. standard edition / 7. compliance matrix / 8. conformity assessment / 9. authorized sign-off / 10. evidence package

[Why these answers fit, page 139](#)

F Check accuracy and scope

A ratio is not a compliance decision

Return to the case

Engineer Rosa and assurance lead Malik review a fictional design note labeled compliant. A preliminary static model reports a safety factor of 2.0 using its stated capacity-to-demand convention. The applicable requirement, acceptance threshold, and reviewer are not identified. Fatigue and dynamic loading are outside the model. No release approval or formal conformity assessment is recorded. Rosa must correct the note without claiming the design is either safe or unsafe from the ratio alone.

Choose one answer per question. Use the case facts and keep any uncertainty or limits intact.

1. The static factor is 2.0 and fatigue is outside the model. Which conclusion is justified?

- A. Fatigue can be ignored once the static factor exceeds one.
- B. Fatigue performance is not established by this model; it needs an appropriate assessment basis.
- C. Fatigue life is doubled because the factor is two.
- D. Fatigue has failed because the report omits it.

2. What should a compliance matrix connect?

- A. Every possible standard regardless of relevance
- B. A release signature with no stated scope
- C. Applicable requirements, evidence, and assessment status
- D. Only the project team's preferred conclusion

[Answers and explanations, page 141](#)

Listen for the distinction

Switch roles. Name the unidentified requirement and excluded fatigue and dynamic effects without declaring universal safety or failure.

Ask what compliant refers to

Compliance is a relationship to specific applicable requirements, not a general compliment about design quality. Ask for the requirement, version, evidence, limitations, and authorized decision. A numerical margin may be useful evidence, but its meaning depends on the model and the failure modes considered.

F Say it / transfer to a new case

Keep the model inside its scope

A preliminary static report gives a factor of 1.8 under its stated convention. It excludes fatigue, has no identified acceptance threshold, and has not received release approval.

Complete the four gaps. With a partner, read alternate roles, then switch. Studying alone, read both roles and pause before each response.

WORD AND PHRASE BANK

static / unidentified / granted / fatigue

- 01 **Engineer:** The reported value belongs to the ¹ _____ model.
- 02 **Reviewer:** The model excludes ² _____.
- 03 **Engineer:** The acceptance threshold remains ³ _____.
- 04 **Reviewer:** Release approval has not been ⁴ _____.

CHECK THE GAPS

1. static / 2. fatigue / 3. unidentified / 4. granted

[Why these answers fit, page 141](#)

Rebuild the exchange

Choose the missing response. Read the completed three-turn exchange aloud, changing roles on the second reading.

1. Rebuild the exchange from "A ratio is not a compliance decision". Rosa: "I can organize the record so each applicable requirement points to the analysis or test evidence and shows whether assessment is complete, open, or awaiting review." Malik: [missing response] Rosa: "We also have no formal conformity assessment recorded. I should not write as though assembling the internal note has completed whatever external or internal route applies." Which response belongs in the gap?

- A.** That is the purpose of a compliance matrix. It should expose the missing links rather than turn a single favorable calculation into a blanket green status.
- B.** Those are important analysis limitations. The reader needs them beside the result, especially if the note might be used to support a broader design or release decision.
- C.** Then describe the factor of safety on that limited basis. Two is the reported preliminary value, not a universal rule that establishes compliance for every design.
- D.** Start with the applicable requirement. Compliant with what, and on which acceptance basis? A favorable number does not identify the requirement or the scope of the conclusion.

[Answers and explanations, page 142](#)

Review 3 / Meaning and context

Use language from the lessons you have completed. Choose one answer per question.

Case file

Revisit "Manufacturability and Cost Engineering" and "Safety Factors and Compliance". Choose precise terminology, then reconstruct the missing responses using both neighboring turns. The final two questions also revisit earlier conversations.

1. A colleague needs the term for this meaning: Design choices suited to the intended manufacturing process, abbreviated DFM. Which term fits?

- A. scrap allowance
- B. break-even volume
- C. design for manufacture
- D. nonrecurring cost

2. A colleague needs the term for this meaning: Capacity associated with a defined ultimate failure limit. Which term fits?

- A. ultimate capacity
- B. model validity
- C. factor of safety
- D. standard edition

3. Rebuild the exchange from "Three passes do not mean every condition". Amina: "The intended operating range is ten to forty degrees. Since we tested only twenty, the other temperatures remain a gap rather than a demonstrated pass." Ben: [missing response] Amina: "Would it help to distinguish checking this performance criterion from confirming that the product works adequately for its intended users and operating tasks?" Which response belongs in the gap?

- A. That is a test coverage limitation. State it directly; do not imply the untested temperatures failed, but do not label them verified either.
- B. Then that would be unsupported extrapolation. Do not substitute a plausible expectation for evidence, especially when the presentation may guide a release or customer commitment.
- C. Exactly. Keep the sample size visible. A percentage can sound much more comprehensive than the underlying evidence when the number of tested items is omitted.
- D. Then the largest observed maximum was one hundred seventy-five. That is twenty-five milliseconds below the criterion, but it is not a universal product limit.

Review 3 / Meaning and context / continued

4. Rebuild the exchange from "A ratio is not a compliance decision". Rosa: "Then the revised note can preserve the factor of two, identify the model exclusions, and say that the compliance conclusion remains unestablished pending the required review." Malik: [missing response] Rosa: "I will keep the current restrictions visible and identify who will confirm the requirements and review the evidence. I will not call the design either safe or unsafe from this ratio alone." Which response belongs in the gap?

- A.** Correct. The conformity assessment route needs confirmation for this product and jurisdiction. This discussion cannot replace the responsible specialists or the required process.
- B.** Yes, including the relevant standard edition where a standard applies. Do not list an impressive collection of references without establishing their relevance and authority.
- C.** Exactly. Name the failure criterion and the relevant inputs. A ratio without that context can sound precise while leaving its actual technical meaning unclear.
- D.** Also distinguish that from authorized sign-off. No release approval is recorded, and a technical result must not silently become permission to proceed.

[Answers and explanations, page 158](#)

A Read the situation

LESSON 07 / FIELD ISSUES AND CUSTOMER COMMUNICATION

Correct an unsupported causal statement, acknowledge customer impact, and give a useful next update without promising an unconfirmed resolution.

Correct the cause without losing the customer

A customer reports two output interruptions from field unit L18. Service engineer Marco previously emailed that humidity caused the interruptions, although humidity remains only a hypothesis and no root cause is confirmed. Customer engineer Nia requests a correction and a resolution date. The investigation is open; records are being gathered, no repair or operating change is authorized, and Marco can commit only to an update by 10 a.m. on October 2. The cases are fictional and supply no instruction to continue operating the unit.

People: Nia, Customer engineer; Marco, Service engineer.

Read the record

Choose one answer per question using the facts above.

1. What needs correction?

- A. Humidity was stated as a confirmed cause without confirmation.
- B. The customer reported only one interruption.
- C. A repair was authorized but not recorded.
- D. The investigation was completed before the email.

2. What can Marco commit to?

- A. An update by 10 a.m. on October 2
- B. A completed repair by 10 a.m. on October 2
- C. A confirmed cause before any record review
- D. Unrestricted continued operation

3. Which statement preserves the customer's report?

- A. Every unit has a humidity defect.
- B. L18 is known to be unaffected.
- C. The interruptions did not occur because the cause is unknown.
- D. Unit L18 has two reported output interruptions.

[Answers and explanations, page 143](#)

B Vocabulary in use

CORE TERMS

field report

Information about product behavior in actual use.

assess a field report

reported symptom

Behavior described by a user but not necessarily independently verified.

record the reported symptom

working hypothesis

A provisional explanation guiding investigation.

qualify the working hypothesis

correction notice

A message explicitly amending earlier information.

issue a correction notice

unit serial number

A unique identifier for an individual product unit.

confirm the unit serial number

operating history

Records of how and when a unit has been used.

request operating history

customer impact

The effect of an issue on the customer's work or results.

acknowledge customer impact

confirmed finding

A conclusion supported by the completed relevant checks.

separate confirmed findings

causal statement

Wording that says one condition produced another.

correct a causal statement

case reference

An identifier connecting records for the same issue.

use the case reference

installed configuration

The hardware, software, and settings present in the field.

document the installed configuration

evidence request

A specific request for information needed in an investigation.

make an evidence request

Say it in context

Stress the highlighted expression. Keep the surrounding words connected; pause at the end of the phrase.

field report **FIELD REPORT**

assess a field report

Keep the meaning precise: Information about product behavior in actual use.

causal statement **CAUSAL STATEMENT**

correct a causal statement

Keep the meaning precise: Wording that says one condition produced another.

B Precision and professional shorthand

EXTEND YOUR RANGE

traceable record

A record connected to its source, time, and relevant item.

retain a traceable record

chain of custody

A record of possession and transfer of evidence or an item.

maintain chain of custody

field action

A coordinated response affecting products in use.

assess a field action

interim update

A progress report before the final outcome is available.

provide an interim update

update cadence

The agreed frequency or timing of progress communication.

agree an update cadence

case owner

The person responsible for coordinating a case.

name the case owner

return authorization

Permission and arrangements for returning an item.

confirm return authorization

service instruction

An authorized direction for servicing or handling a product.

follow the service instruction

impact statement

A bounded description of an issue's effects.

prepare an impact statement

resolution commitment

A promise about when or how an issue will be resolved.

avoid an unsupported resolution commitment

escalation contact

The named route for raising concerns requiring further attention.

identify the escalation contact

closure confirmation

A recorded check that the case's closure conditions are met.

obtain closure confirmation

Say it in context

Stress the highlighted expression. Keep the surrounding words connected; pause at the end of the phrase.

evidence request EVIDENCE REQUEST

make an evidence request

Keep the meaning precise: A specific request for information needed in an investigation.

field action FIELD ACTION

assess a field action

Keep the meaning precise: A coordinated response affecting products in use.

Phrases that move the work forward

Acknowledge the correction

Our earlier email overstated the cause.

Preserve the hypothesis

It remains one explanation under investigation.

Acknowledge the impact

I understand that the uncertainty affects your planning.

Avoid false reassurance

We do not yet have evidence to rule out recurrence.

State the next contact

I will update you by 10 a.m. on October 2.

Keep authority clear

No repair or operating change is authorized by this message.

Connect the correction

Attach this correction to the same case record.

Avoid premature closure

Sending the correction does not close the investigation.

Withdraw the unsupported claim

Humidity has not been confirmed as the cause.

Recognize the report

We have recorded two interruptions on unit L18.

Ask for specific records

Please connect each event to its time and installed configuration.

Separate the commitments

I can commit to an update, not a resolution date.

Define update contents

The update will distinguish findings, open questions, and next steps.

Route service decisions

Product-specific instructions must come through the authorized service process.

Name ownership

I remain the case owner for communication.

Close the loop

Please confirm that the corrected status reached the relevant team.

Precision in real exchanges

Purpose: Recognize the report

Useful wording: We have recorded two interruptions on unit L18.

Purpose: Acknowledge the impact

Useful wording: I understand that the uncertainty affects your planning.

D Choose the response that fits

Choose one response for each situation. Preserve the facts, the decision boundary, and the purpose of the exchange.

1. Which opening best corrects the earlier message?

- A.** The customer report is withdrawn because we lack a cause.
- B.** Our email overstated the cause; humidity remains unconfirmed.
- C.** As previously confirmed, humidity is probably responsible.
- D.** We have slightly refined our wording but the conclusion is unchanged.

2. Which deadline statement is supported?

- A.** I will send an investigation update by 10 a.m. on October 2.
- B.** The unit will be repaired by 10 a.m. on October 2.
- C.** We guarantee no further interruptions before October 2.
- D.** The investigation must be closed before the next message.

3. A colleague needs the term for this meaning: A conclusion supported by the completed relevant checks. Which term fits?

- A.** chain of custody
- B.** unit serial number
- C.** confirmed finding
- D.** update cadence

D Choose the response that fits / continued

4. Rebuild the exchange from "Correct the cause without losing the customer". Nia: "Should our internal summary remove humidity entirely? I want it to be accurate without hiding an explanation that your engineers are still examining." Marco: [missing response] Nia: "Please identify the earlier email in the correction. People are still forwarding it, so they need an explicit statement that the cause has not been confirmed." Which response belongs in the gap?

- A.** I will issue a correction notice on the same case. It will say that our previous message overstated the cause and that the investigation remains open.
- B.** We will preserve the field report. The correction concerns our explanation, not whether your team raised the events. Both reports remain part of the investigation for this unit.
- C.** The interim update will separate confirmed findings, open hypotheses, outstanding evidence, and the next review point. It will not turn the communication deadline into a promised repair date.
- D.** Describe it as a working hypothesis. It is one explanation being investigated, not a confirmed finding and not something we have ruled out through completed checks.

[Answers and explanations, page 143](#)

One useful distinction

Reported interruptions are not erased by uncertainty about cause. The error is the email saying humidity caused them. The correction should explicitly withdraw that unsupported conclusion while preserving humidity as a hypothesis and the customer report as relevant evidence.

E Conversation

Correct the cause without losing the customer

Correct the cause without losing the customer

Complete the numbered gaps. Use each bank entry once; some entries contain several words.

WORD AND PHRASE BANK

resolution commitment / interim update / correction notice / traceable record /
Closure confirmation / working hypothesis / case owner / service instruction /
causal statement / field report

- 01 **Nia:** Your email said humidity caused the two interruptions on L18. Our team now understands that the cause has not been confirmed, so we need the record corrected.
- 02 **Marco:** You are right. The earlier ¹ _____ was too strong. Humidity is unconfirmed, and I will explicitly correct the message rather than quietly change the wording in our next update.
- 03 **Nia:** Please keep the two interruptions in the record. Uncertainty about the explanation does not change what our operators reported or the disruption they experienced.
- 04 **Marco:** We will preserve the ² _____. The correction concerns our explanation, not whether your team raised the events. Both reports remain part of the investigation for this unit.
- 05 **Nia:** Should our internal summary remove humidity entirely? I want it to be accurate without hiding an explanation that your engineers are still examining.
- 06 **Marco:** Describe it as a ³ _____. It is one explanation being investigated, not a confirmed finding and not something we have ruled out through completed checks.

E Conversation / continued

- 07 **Nia:** Please identify the earlier email in the correction. People are still forwarding it, so they need an explicit statement that the cause has not been confirmed.
- 08 **Marco:** I will issue a ⁴ _____ on the same case. It will say that our previous message overstated the cause and that the investigation remains open.
- 09 **Nia:** We can supply the event times and the installed version information. Tell us how to connect those records so the engineers can distinguish the two occurrences.
- 10 **Marco:** Each ⁵ _____ should identify L18, the event time, and the installed configuration. We will coordinate the evidence request through the case rather than ask you to guess which material matters.

Conversation continues on the next page.

Correct the cause without losing the customer

CONVERSATION / CONTINUED

- 11 **Nia:** Planning needs a date. What can you commit to now, and what is still preventing a resolution estimate?
- 12 **Marco:** I cannot give a ⁶ _____ yet. I can commit to an update by ten a.m. on October second, and I understand that uncertainty creates a planning burden for you.
- 13 **Nia:** What will that update contain if the cause is still open? Saying we are working on it would give us little new information.
- 14 **Marco:** The ⁷ _____ will separate confirmed findings, open hypotheses, outstanding evidence, and the next review point. It will not turn the communication deadline into a promised repair date.
- 15 **Nia:** One colleague asked whether the correction means we should change how the unit is used or attempt a repair. We have not received an authorized instruction.
- 16 **Marco:** This message is not a ⁸ _____. Any operating or repair direction must come through the authorized product-specific process. I will route that question to the responsible team rather than improvise an answer.
- 17 **Nia:** Please clarify ownership. We have heard from several people, and we need to know who will collect the questions and respond.
- 18 **Marco:** I will remain the ⁹ _____ for communication. Your questions will stay linked to the same record, and I will identify the appropriate escalation contact if additional attention is needed.
- 19 **Nia:** That gives us a usable correction and a clear next contact. I will circulate the amended status, but I will not mark the technical issue resolved.
- 20 **Marco:** Correct. ¹⁰ _____ comes only when the relevant conditions are met. Today's correction restores an accurate record while the investigation and technical decisions continue.

CHECK THE GAPS

1. causal statement / 2. field report / 3. working hypothesis / 4. correction notice / 5. traceable record / 6. resolution commitment / 7. interim update / 8. service instruction / 9. case owner / 10. Closure confirmation

[Why these answers fit, page 144](#)

F Check accuracy and scope

Correct the cause without losing the customer

Return to the case

A customer reports two output interruptions from field unit L18. Service engineer Marco previously emailed that humidity caused the interruptions, although humidity remains only a hypothesis and no root cause is confirmed. Customer engineer Nia requests a correction and a resolution date. The investigation is open; records are being gathered, no repair or operating change is authorized, and Marco can commit only to an update by 10 a.m. on October 2. The cases are fictional and supply no instruction to continue operating the unit.

Choose one answer per question. Use the case facts and keep any uncertainty or limits intact.

1. Which request could help distinguish causes without presuming humidity is responsible?

- A. Supply only a summary supporting the first email's conclusion.
- B. Provide event times, installed configuration, and available environmental records linked to L18.
- C. Confirm that each interruption was humidity-related before sending the original logs.
- D. Remove events that occurred during apparently normal humidity.

2. What should the correction not imply?

- A. That the investigation is still open
- B. Permission to change operation or perform an unapproved repair
- C. That the earlier causal claim was too strong
- D. That the cause remains unresolved

[Answers and explanations, page 146](#)

Listen for the distinction

Switch roles. Promise the October 2, 10 a.m. update without creating a repair deadline or operating instruction.

Correct the record explicitly

A quiet change of wording may leave the customer relying on the earlier claim. Identify what was overstated, give the corrected status, and acknowledge the practical effect of uncertainty. A promised update is valuable when it specifies what will be reported, even if resolution timing remains unknown.

F Say it / transfer to a new case

An update is not a repair promise

A supplier wrongly called contamination the confirmed cause. It is still a hypothesis. The investigation is open. The supplier promises a progress report Friday at noon, not a repair.

Complete the four gaps. With a partner, read alternate roles, then switch. Studying alone, read both roles and pause before each response.

WORD AND PHRASE BANK

open / update / correction / hypothesis

- 01 **Supplier:** Our earlier claim needs a ¹ _____.
- 02 **Customer:** Contamination remains a ² _____.
- 03 **Supplier:** Friday noon is the next ³ _____.
- 04 **Customer:** The investigation remains ⁴ _____.

CHECK THE GAPS

1. correction / 2. hypothesis / 3. update / 4. open

[Why these answers fit, page 146](#)

Rebuild the exchange

Choose the missing response. Read the completed three-turn exchange aloud, changing roles on the second reading.

1. Rebuild the exchange from "Correct the cause without losing the customer". Nia: "What will that update contain if the cause is still open? Saying we are working on it would give us little new information." Marco: [missing response] Nia: "One colleague asked whether the correction means we should change how the unit is used or attempt a repair. We have not received an authorized instruction." Which response belongs in the gap?

- A.** We will preserve the field report. The correction concerns our explanation, not whether your team raised the events. Both reports remain part of the investigation for this unit.
- B.** The interim update will separate confirmed findings, open hypotheses, outstanding evidence, and the next review point. It will not turn the communication deadline into a promised repair date.
- C.** Describe it as a working hypothesis. It is one explanation being investigated, not a confirmed finding and not something we have ruled out through completed checks.
- D.** You are right. The earlier causal statement was too strong. Humidity is unconfirmed, and I will explicitly correct the message rather than quietly change the wording in our next update.

[Answers and explanations, page 147](#)

A Read the situation

LESSON 08 / SYSTEMS INTEGRATION AND INTERFACE CONTROL

Explain an interface mismatch using configuration, units, and affected evidence while coordinating a controlled integration decision.

The same number, a different unit

Hardware lead Isabel and software lead Noah integrate a fictional measurement display with no control output. Approved interface document revision 1 defines each transmitted count as 1 mm. Hardware test build H2 instead sends hundredths of a millimeter: 100 counts means 1 mm. Existing software S1 still interprets 100 counts as 100 mm. Earlier tests used H1, S1, and revision 1. A revision-2 interface proposal is not approved, and the impact review and retest plan are incomplete. No production release is authorized.

People: Isabel, Hardware lead; Noah, Software lead.

Read the record

Choose one answer per question using the facts above.

1. What does 100 counts mean for H2?

- A. 100 mm
- B. 0.01 mm
- C. 10,000 mm
- D. 1 mm

2. What does S1 currently display for those 100 counts?

- A. 100 mm
- B. 1 mm
- C. 0.01 mm
- D. An explicitly supplied error code

3. Which configuration has the earlier test evidence?

- A. H2 with an approved revision 2
- B. Every possible hardware and software pairing
- C. H2 with a completed retest plan
- D. H1 with S1 under revision 1

[Answers and explanations, page 148](#)

B Vocabulary in use

CORE TERMS

interface control document

A controlled definition of an interface, abbreviated ICD.

update the interface control document

configuration baseline

The approved set of identified versions used as a reference.

establish the configuration baseline

software version

An identified release or build of software.

record the software version

regression test

A check that changes have not broken previously working behavior.

define regression tests

payload

The data carried inside a message or transmission.

inspect the payload

field width

The size allocated to a data field.

confirm the field width

interface contract

The agreed expectations for interaction between components.

define the interface contract

hardware build

An identified version or assembly of hardware.

identify the hardware build

integration test

A test of components working together.

run an integration test

unit scaling

The conversion between encoded values and physical units.

document unit scaling

data type

The defined representation and permitted operations for a value.

specify the data type

byte order

The sequence used to store or transmit a multi-byte value.

specify byte order

Say it in context

Stress the highlighted expression. Keep the surrounding words connected; pause at the end of the phrase.

interface control document **INTERFACE CONTROL DOCUMENT**

update the interface control document

Keep the meaning precise: A controlled definition of an interface, abbreviated ICD.

integration test **INTEGRATION TEST**

run an integration test

Keep the meaning precise: A test of components working together.

B Precision and professional shorthand

EXTEND YOUR RANGE

message schema

The defined structure and meaning of a message.

version the message schema

version negotiation

A process for identifying or agreeing compatible interface versions.

define version negotiation

change impact analysis

Assessment of the consequences of a proposed or actual change.

complete change impact analysis

test evidence reuse

Using earlier results where their continued applicability is justified.

justify test evidence reuse

interface owner

The role responsible for maintaining the interface definition.

identify the interface owner

configuration record

A record identifying the versions and settings used.

preserve the configuration record

backward compatibility

Ability to work with an earlier version under stated conditions.

assess backward compatibility

configuration mismatch

A combination of versions that does not share the expected contract.

identify a configuration mismatch

affected test

A test whose relevance or expected result changes with the modification.

identify affected tests

conversion factor

A multiplier used to express a value on another unit basis.

apply the conversion factor

change approval

Authorization to make a defined controlled change.

obtain change approval

integration readiness

The state of having the agreed inputs and evidence needed to integrate.

assess integration readiness

Say it in context

Stress the highlighted expression. Keep the surrounding words connected; pause at the end of the phrase.

byte order BYTE ORDER

specify byte order

Keep the meaning precise: The sequence used to store or transmit a multi-byte value.

change impact analysis CHANGE IMPACT ANALYSIS

complete change impact analysis

Keep the meaning precise: Assessment of the consequences of a proposed or actual change.

Phrases that move the work forward

Identify the pairing

Which hardware build and software version are under test?

State the change

H2 sends hundredths of a millimeter.

Separate connection from meaning

A received message can still be interpreted incorrectly.

Preserve the old result

The earlier evidence applies to H1 with S1.

Avoid blanket deletion

Unaffected evidence may be reusable with justification.

Bound the review

Assess decoding, display, records, and affected tests.

Require a controlled decision

Route the proposed change through the approval process.

Record the exact configuration

Store the hardware, software, and interface versions with the result.

Name the contract

The approved interface is still revision 1.

Show the consequence

One hundred counts means 1 mm for H2 but 100 mm for S1.

Check the scale

What conversion factor does this version apply?

Avoid blanket reuse

That result does not automatically cover the new pairing.

Identify the proposal

Revision 2 is not yet approved.

Name interface ownership

Who owns the shared interface definition?

Plan the retest

Link each affected requirement to the appropriate test.

Close without overclaim

Integration and production release remain pending.

Precision in real exchanges

Purpose: Show the consequence

Useful wording: One hundred counts means 1 mm for H2 but 100 mm for S1.

Purpose: Separate connection from meaning

Useful wording: A received message can still be interpreted incorrectly.

D Choose the response that fits

Choose one response for each situation. Preserve the facts, the decision boundary, and the purpose of the exchange.

1. Which diagnosis matches the facts?

- A.** The earlier test proves S1 handles every scaling convention.
- B.** H2 and S1 use different scaling for the same transmitted count.
- C.** The customer has approved revision 2.
- D.** The interface is compatible because a number can be transmitted.

2. For H2's 100-count message, which correction addresses the unit meaning?

- A.** Keep the displayed value 100 and relabel it mm, because the packet arrived.
- B.** Multiply 100 by 100 to compensate for the smaller encoded unit.
- C.** Multiply 100 by 0.01 mm per count to obtain 1 mm; changing only the display label is insufficient.
- D.** Divide 100 by 0.01 to obtain 10,000 mm.

3. A colleague needs the term for this meaning: An identified version or assembly of hardware. Which term fits?

- A.** interface owner
- B.** version negotiation
- C.** payload
- D.** hardware build

D Choose the response that fits / continued

4. Rebuild the exchange from "The same number, a different unit". Noah: "Our earlier test passed. Before anybody uses that result to clear H2, which actual builds and interface revision did the test cover?" Isabel: [missing response] Noah: "I found the revision-two proposal in the folder. Its presence does not mean the new scale is approved, even though the hardware test build already uses it." Which response belongs in the gap?

- A.** H2 sends one hundred, but its unit scaling is now hundredths of a millimeter. The approved revision-one interface still defines whole millimeters per count.
- B.** Correct. The interface control document still needs controlled review and approval. A new test build cannot silently replace the shared definition for the software team.
- C.** Assess test evidence reuse against the change. Keep applicable results with their original configuration references, and identify where changed behavior needs new evidence.
- D.** The configuration record says H1, S1, revision one. Preserve that result as evidence for that combination; it was not a test of H2.

[Answers and explanations, page 148](#)

One useful distinction

The mismatch is semantic: the number has a different unit scale. For H2, 100 counts times 0.01 mm per count equals 1 mm. S1 applies 1 mm per count and displays 100 mm. A successful message transfer would not establish correct interpretation.

E Conversation

The same number, a different unit

The same number, a different unit

Complete the numbered gaps. Use each bank entry once; some entries contain several words.

WORD AND PHRASE BANK

integration readiness / test evidence reuse / conversion factor / interface owner /
unit scaling / configuration record / configuration mismatch / regression tests /
change impact analysis / interface control document

- 01 **Noah:** The message arrives without an error, but S1 displays one hundred millimeters. You expected one millimeter. Can we compare the transmitted count and its meaning?
- 02 **Isabel:** H2 sends one hundred, but its ¹ _____ is now hundredths of a millimeter. The approved revision-one interface still defines whole millimeters per count.
- 03 **Noah:** Then S1 is applying its documented multiplier of one. The number was received, but this pairing interprets it one hundred times too large.
- 04 **Isabel:** Yes, we have a ² _____. A successful packet transfer does not demonstrate agreement about physical units.
- 05 **Noah:** Our earlier test passed. Before anybody uses that result to clear H2, which actual builds and interface revision did the test cover?
- 06 **Isabel:** The ³ _____ says H1, S1, revision one. Preserve that result as evidence for that combination; it was not a test of H2.
- 07 **Noah:** I found the revision-two proposal in the folder. Its presence does not mean the new scale is approved, even though the hardware test build already uses it.
- 08 **Isabel:** Correct. The ⁴ _____ still needs controlled review and approval. A new test build cannot silently replace the shared definition for the software team.
- 09 **Noah:** For the proposed scale, should I divide one hundred by zero point zero one? That would produce ten thousand millimeters, which makes the mismatch worse.
- 10 **Isabel:** Multiply by the ⁵ _____ instead: zero point zero one millimeters per count. One hundred counts then gives one millimeter. Include that worked example in the proposal.

Conversation continues on the next page.

The same number, a different unit

CONVERSATION / CONTINUED

- 11 **Noah:** Could we just change the label beside the displayed number? The field name and packet size are unchanged, so the patch could look quite small.
- 12 **Isabel:** A label alone would leave the value wrong. The ⁶ _____ must follow decoding, display, stored records, and any other uses of the physical quantity.
- 13 **Noah:** Should I discard every earlier test, or can some results remain useful? I want to avoid both unsupported reuse and rerunning unrelated checks without a reason.
- 14 **Isabel:** Assess ⁷ _____ against the change. Keep applicable results with their original configuration references, and identify where changed behavior needs new evidence.
- 15 **Noah:** I will list affected requirements and expected values for the proposed pairing. The tests should catch both a wrong factor and a correct-looking number from the wrong configuration.
- 16 **Isabel:** Include ⁸ _____ for previously working behavior within the assessed scope. A direct scaling check alone does not establish that the rest of the affected behavior is unchanged.
- 17 **Noah:** Who will maintain the shared definition? Separate hardware and software notes could leave us with this disagreement again at the next test.
- 18 **Isabel:** We need a named ⁹ _____ and a confirmed approval route. I will bring the hardware-build details; please attach the software interpretation and affected-test list.
- 19 **Noah:** I will. Today's outcome is an understood scaling mismatch and assigned evidence preparation, not an approved new interface or production release.
- 20 **Isabel:** Agreed. Establishing ¹⁰ _____ still needs the controlled definition, compatible configuration, and reviewed evidence. We will not relabel the earlier pass as proof for H2.

CHECK THE GAPS

1. unit scaling / 2. configuration mismatch / 3. configuration record / 4. interface control document / 5. conversion factor / 6. change impact analysis / 7. test evidence reuse / 8. regression tests / 9. interface owner / 10. integration readiness

[Why these answers fit, page 149](#)

F Check accuracy and scope

The same number, a different unit

Return to the case

Hardware lead Isabel and software lead Noah integrate a fictional measurement display with no control output. Approved interface document revision 1 defines each transmitted count as 1 mm. Hardware test build H2 instead sends hundredths of a millimeter: 100 counts means 1 mm. Existing software S1 still interprets 100 counts as 100 mm. Earlier tests used H1, S1, and revision 1. A revision-2 interface proposal is not approved, and the impact review and retest plan are incomplete. No production release is authorized.

Choose one answer per question. Use the case facts and keep any uncertainty or limits intact.

1. How should earlier evidence be treated?

- A. Preserve it and assess which results remain applicable to the changed configuration.
- B. Relabel all earlier results as H2 tests.
- C. Delete all results without an impact review.
- D. Declare the new interface approved because earlier tests passed.

2. What is needed before claiming integration readiness?

- A. Only a message received without a connection error
- B. Only the existence of a draft revision 2
- C. A statement that both teams prefer the new units
- D. A resolved interface definition, controlled configuration, and appropriate reviewed test evidence

[Answers and explanations, page 151](#)

Listen for the distinction

Switch roles for turns 11-20. Keep evidence for H1/S1/revision 1 separate from the unapproved H2 proposal.

Compatibility includes meaning

Teams may use the same connector, packet length, and field name while interpreting a value differently. State the units and scaling explicitly. When an interface changes, connect the proposed contract, actual builds, affected tests, and approval route instead of assuming a successful connection proves compatibility.

F Say it / transfer to a new case

A count needs its conversion

A proposed interface uses 0.1 mm per count. A test message contains 50 counts, so its intended distance is 5 mm. Old software uses 1 mm per count and displays 50 mm. The proposal is unapproved.

Complete the four gaps. With a partner, read alternate roles, then switch. Studying alone, read both roles and pause before each response.

WORD AND PHRASE BANK

scaling / 50 / 5 / approval

- 01 **Engineer:** The proposed distance is ¹ _____ mm.
- 02 **Reviewer:** The old software displays ² _____ mm.
- 03 **Engineer:** The difference comes from unit ³ _____.
- 04 **Reviewer:** The proposed change still needs ⁴ _____.

CHECK THE GAPS

1. 5 / 2. 50 / 3. scaling / 4. approval

[Why these answers fit, page 151](#)

F Say it / transfer to a new case / continued

Rebuild the exchange

Choose the missing response. Read the completed three-turn exchange aloud, changing roles on the second reading.

1. Rebuild the exchange from "The same number, a different unit". Noah: "Should I discard every earlier test, or can some results remain useful? I want to avoid both unsupported reuse and rerunning unrelated checks without a reason." Isabel: [missing response] Noah: "I will list affected requirements and expected values for the proposed pairing. The tests should catch both a wrong factor and a correct-looking number from the wrong configuration." Which response belongs in the gap?

- A.** Correct. The interface control document still needs controlled review and approval. A new test build cannot silently replace the shared definition for the software team.
- B.** H2 sends one hundred, but its unit scaling is now hundredths of a millimeter. The approved revision-one interface still defines whole millimeters per count.
- C.** The configuration record says H1, S1, revision one. Preserve that result as evidence for that combination; it was not a test of H2.
- D.** Assess test evidence reuse against the change. Keep applicable results with their original configuration references, and identify where changed behavior needs new evidence.

[Answers and explanations, page 152](#)

Review 4 / Meaning and context

Use language from the lessons you have completed. Choose one answer per question.

Case file

Revisit "Field Issues and Customer Communication" and "Systems Integration and Interface Control". Choose precise terminology, then reconstruct the missing responses using both neighboring turns. The final two questions also revisit earlier conversations.

1. A colleague needs the term for this meaning: Behavior described by a user but not necessarily independently verified. Which term fits?

- A. reported symptom
- B. resolution commitment
- C. return authorization
- D. case reference

2. A colleague needs the term for this meaning: The conversion between encoded values and physical units. Which term fits?

- A. test evidence reuse
- B. unit scaling
- C. interface control document
- D. message schema

3. Rebuild the exchange from "A ratio is not a compliance decision". Rosa: "Could I say the static result is encouraging, provided I avoid saying it proves the product safe? I do not want to hide useful work either." Malik: [missing response] Rosa: "I will check the contract requirements too. Can we identify the applicable documents and versions before the note lists standards that may not govern this product?" Which response belongs in the gap?

- A. Report the result, but keep model validity and review status explicit. The model must be suitable for the claim, and the acceptance basis still needs to be identified.
- B. Those are important analysis limitations. The reader needs them beside the result, especially if the note might be used to support a broader design or release decision.
- C. Start with the applicable requirement. Compliant with what, and on which acceptance basis? A favorable number does not identify the requirement or the scope of the conclusion.
- D. Good. The evidence package should let a qualified decision maker see what is supported and what is missing. That is more useful than an unsupported compliance label.

Review 4 / Meaning and context / continued

4. Rebuild the exchange from "The same number, a different unit". Noah: "Who will maintain the shared definition? Separate hardware and software notes could leave us with this disagreement again at the next test." Isabel: [missing response] Noah: "I will. Today's outcome is an understood scaling mismatch and assigned evidence preparation, not an approved new interface or production release." Which response belongs in the gap?

- A.** H2 sends one hundred, but its unit scaling is now hundredths of a millimeter. The approved revision-one interface still defines whole millimeters per count.
- B.** Correct. The interface control document still needs controlled review and approval. A new test build cannot silently replace the shared definition for the software team.
- C.** Agreed. Establishing integration readiness still needs the controlled definition, compatible configuration, and reviewed evidence. We will not relabel the earlier pass as proof for H2.
- D.** We need a named interface owner and a confirmed approval route. I will bring the hardware-build details; please attach the software interpretation and affected-test list.

[Answers and explanations, page 161](#)

Language for the next case

A smoother plot is not a convergence study

quantity of interest

The quantity of interest is the specific output used for the intended assessment; different outputs may behave differently under refinement.

Yara: We need to name the quantity of interest. Displacement changes little between these runs, but the peak stress keeps rising.

stress singularity

A stress singularity can occur at an idealized geometric or loading feature, producing a local stress that does not converge to a finite value with refinement.

Yara: A stress singularity is one possibility to investigate. We must assess the idealization rather than automatically interpret each higher peak as a new physical measurement.

Verification

Verification addresses whether the model implementation and numerical solution are correct for the specified model; it is distinct from assessing representation of reality.

Yara: No. Verification and comparison with relevant physical evidence answer different questions. Passing a numerical check does not automatically validate the intended real-world use.

Mesh convergence

Mesh convergence concerns the behavior of a specified result as the discretization is refined; stability of one output does not establish it for every output.

Yara: No. Mesh convergence concerns the relevant output and purpose. One stable measure does not establish stability for every value.

boundary conditions

Boundary conditions define how the modeled system is constrained or interacts with its surroundings; they must represent the intended assessment adequately.

Yara: The boundary conditions, load case, material assumptions, geometry, and relevant solution settings. The picture alone does not tell reviewers what physical problem we solved.

sensitivity analysis

Sensitivity analysis examines how outputs change when selected inputs or assumptions vary; it helps identify which uncertainties matter to the conclusion.

Yara: Yes, and include sensitivity analysis where appropriate. A conclusion that changes sharply with an uncertain input needs that sensitivity explained.

Read the phrases aloud. Then complete the conversation on the following pages using the word bank.

Conversation

A smoother plot is not a convergence study

Three finite-element runs use progressively finer meshes. Displacement changes little, but peak stress at an idealized sharp corner keeps increasing. The design lead wants a green pass label. No acceptance threshold or release conclusion is supplied.

Complete the numbered gaps. Use each bank entry once; some entries contain several words.

WORD AND PHRASE BANK

quantity of interest / boundary conditions / stress singularity / Verification /
sensitivity analysis / Mesh convergence

- 01 **Finn:** The latest plot looks much smoother. Can we call the model converged and put the result into the release review?
- 02 **Yara:** We need to name the ¹ _____. Displacement changes little between these runs, but the peak stress keeps rising.
- 03 **Finn:** I assumed a finer mesh improved every result in the same way. Does the stable displacement not settle the whole model?
- 04 **Yara:** No. ² _____ concerns the relevant output and purpose. One stable measure does not establish stability for every value.
- 05 **Finn:** The rising stress is at that sharp inside corner. Could the model geometry itself explain why the local maximum does not settle?
- 06 **Yara:** A ³ _____ is one possibility to investigate. We must assess the idealization rather than automatically interpret each higher peak as a new physical measurement.

Conversation / continued

- 07 **Finn:** But we should not simply delete the red area from the plot and call the design satisfactory either.
- 08 **Yara:** Exactly. We need a justified assessment of the actual feature and intended failure criterion, with the limitations visible. Changing the display is not solving the engineering question.
- 09 **Finn:** What should the review package show about the supports and loads? The slide currently only has the colored result.
- 10 **Yara:** The ⁴ _____, load case, material assumptions, geometry, and relevant solution settings. The picture alone does not tell reviewers what physical problem we solved.

Conversation continues on the next page.

A smoother plot is not a convergence study

CONVERSATION / CONTINUED

- 11 **Finn:** The supplier says their model uses the same material name. Should we expect identical results when we compare them?
- 12 **Yara:** Not without checking the actual properties, formulations, geometry, and conditions. A shared label does not establish equivalent inputs or methods.
- 13 **Finn:** We have also checked the implementation against a known calculation. Is that the same as showing that the model represents the real assembly?
- 14 **Yara:** No. ⁵ _____ and comparison with relevant physical evidence answer different questions. Passing a numerical check does not automatically validate the intended real-world use.
- 15 **Finn:** Then the hardware comparison still matters. We need to say which measurements and conditions support the use we are proposing.
- 16 **Yara:** Yes, and include ⁶ _____ where appropriate. A conclusion that changes sharply with an uncertain input needs that sensitivity explained.
- 17 **Finn:** For today, I will remove the blanket green label. We can report stable displacement in these runs and the unresolved local-stress interpretation separately.
- 18 **Yara:** That is accurate. I will provide the refinement results and the model assumptions for review, without treating the visual smoothness as acceptance evidence.
- 19 **Finn:** Please also identify what further work is needed for the release question. The reviewers need an actionable gap, not just a warning that models have limitations.
- 20 **Yara:** I will link each open question to the intended claim. That lets us decide what the analysis can support and what still requires assessment.

CHECK THE GAPS

1. quantity of interest / 2. Mesh convergence / 3. stress singularity / 4. boundary conditions / 5. Verification / 6. sensitivity analysis

[Why these answers fit, page 164](#)

One stable output is used to approve every output

A thermal model gives a stable average temperature under mesh refinement, but its local peak is still changing materially.

Complete the exchange using each phrase once. Read both roles, then switch roles and repeat with the bank covered.

WORD AND PHRASE BANK

peak / assessment / report / criterion

- 01 **Lead:** Stability of the average does not establish the local ¹ _____.
- 02 **Analyst:** State the specific quantity of interest for the ² _____.
- 03 **Lead:** Keep the remaining numerical limitation visible in the ³ _____.
- 04 **Analyst:** A smooth image is not an acceptance ⁴ _____.

CHECK THE GAPS

1. peak / 2. assessment / 3. report / 4. criterion

[Why these answers fit, page 164](#)

Keep the distinction audible

Challenge a simulation claim by asking about the quantity of interest, model assumptions, and supporting evidence.

Language for the next case

The replacement fits, but is it an approved alternate?

form-and-fit

Form-and-fit concerns physical characteristics and compatibility at the mounting or connection interface; it does not establish equivalent function or performance.

Serena: Send me the exact part number and datasheet. A matching envelope establishes part of the form-and-fit comparison, not the complete engineering equivalence.

transfer function

The transfer function here describes the relationship between the measured input and the sensor output; a changed scale can affect downstream interpretation.

Serena: Compare the transfer function. Measuring the same quantity does not mean the receiving system can interpret the output without a change.

approved alternate

An approved alternate has completed the applicable assessment and approval for its defined use; a supplier recommendation or evaluation sample does not establish that status.

Serena: Exactly. An approved alternate has a specific assessed use. We should not let a convenient stock code imply approval across every product.

interface requirements

Interface requirements define the relevant mechanical, electrical, and information connections; a similar connector appearance does not demonstrate compliance.

Serena: We need the actual interface requirements, including those details. A photograph cannot establish that two connected parts behave compatibly.

bill of materials

The bill of materials identifies the parts belonging to the defined product configuration; listing a candidate as approved would misstate its status.

Serena: Keep it as a candidate. The controlled bill of materials must not show it as a production-approved part before the required decision.

effectivity

Effectivity defines where or when an approved change applies, such as specified builds or serial ranges, avoiding an uncontrolled mix of configurations.

Serena: Yes. The effectivity needs to be clear, along with any associated documentation, software, test, or service implications.

Read the phrases aloud. Then complete the conversation on the following pages using the word bank.

Conversation

The replacement fits, but is it an approved alternate?

A proposed replacement sensor has the same connector and envelope dimensions as the unavailable original. Its output scale, accuracy over temperature, and environmental rating remain unassessed. The bill of materials lists only the original. A buyer asks about production use.

Complete the numbered gaps. Use each bank entry once; some entries contain several words.

WORD AND PHRASE BANK

interface requirements / approved alternate / bill of materials / transfer function /
effectivity / form-and-fit

- 01 **Milo:** The usual sensor is unavailable. This one fits the same space and connector, and the supplier calls it a drop-in replacement. Can I order it for production?
- 02 **Serena:** Send me the exact part number and datasheet. A matching envelope establishes part of the ¹ _____ comparison, not the complete engineering equivalence.
- 03 **Milo:** The connector looks identical in the photograph. I have not compared the pin assignments or electrical characteristics yet.
- 04 **Serena:** We need the actual ² _____, including those details. A photograph cannot establish that two connected parts behave compatibly.
- 05 **Milo:** What about the output? The supplier lists the same measured quantity, but the scale is on a different page of the datasheet.
- 06 **Serena:** Compare the ³ _____. Measuring the same quantity does not mean the receiving system can interpret the output without a change.

Conversation / continued

- 07 **Milo:** I also see an accuracy figure measured at room temperature. Our existing requirement covers a wider operating range.
- 08 **Serena:** Then we need evidence across the applicable conditions. A favorable room-temperature value does not automatically meet an accuracy-over-temperature requirement.
- 09 **Milo:** The supplier says they sell it to several similar customers. I can ask for supporting information, but that is not our product assessment.
- 10 **Serena:** Right. We should compare our requirements, including environmental and reliability needs, and identify the gaps. Other customers may have different configurations and use conditions.

Conversation continues on the next page.

The replacement fits, but is it an approved alternate?

CONVERSATION / CONTINUED

- 11 **Milo:** Could I add the part to the purchasing list while engineering finishes the comparison? That would make it easier to place the order quickly later.
- 12 **Serena:** Keep it as a candidate. The controlled ⁴ _____ must not show it as a production-approved part before the required decision.
- 13 **Milo:** Understood. Any samples for evaluation would need their own purchase purpose and handling so they are not mistaken for production stock.
- 14 **Serena:** Exactly. An ⁵ _____ has a specific assessed use. We should not let a convenient stock code imply approval across every product.
- 15 **Milo:** If the comparison supports a change, do we also need to identify which units or builds can use it?
- 16 **Serena:** Yes. The ⁶ _____ needs to be clear, along with any associated documentation, software, test, or service implications.
- 17 **Milo:** I will give you the shortage timing, exact candidate details, and what the supplier can provide. I will not promise production availability yet.
- 18 **Serena:** I will return a requirement-by-requirement comparison and the required review steps. We can show which checks are complete and which still block a decision.
- 19 **Milo:** That gives planning a real status: candidate found, equivalence under assessment, no production substitution approved.
- 20 **Serena:** Yes. The goal is a workable alternative with a documented basis, not merely a part that can be plugged into the same connector.

CHECK THE GAPS

1. form-and-fit / 2. interface requirements / 3. transfer function / 4. bill of materials / 5. approved alternate / 6. effectivity

[Why these answers fit, page 166](#)

A sample order becomes an apparent production approval

A buyer orders a candidate component for engineering evaluation. The purchasing record mistakenly labels it an approved production alternate.

Complete the exchange using each phrase once. Read both roles, then switch roles and repeat with the bank covered.

WORD AND PHRASE BANK

history / requirements / use / alternates

- 01 **Engineer:** These parts were ordered for evaluation, not production ¹ _____.
- 02 **Buyer:** Correct the status without losing the purchase ² _____.
- 03 **Engineer:** Complete the comparison against the applicable ³ _____.
- 04 **Buyer:** Keep the candidate separate from approved ⁴ _____.

CHECK THE GAPS

1. use / 2. history / 3. requirements / 4. alternates

[Why these answers fit, page 166](#)

Keep the distinction audible

Evaluate a proposed component substitution across requirements and product configuration.

Language for the next case

Two settings changed, so which one improved the result?

factors

Factors are the input variables being studied; both fan setting and vent design changed between these runs, so their separate effects are not established.

Dae: Not from these two runs. We changed two factors together, and the ambient temperature was different as well.

interaction

An interaction means the effect of one factor depends on the level of another; separate single-change conclusions may miss that relationship.

Dae: Yes. That is an interaction question. We should choose a reviewed design capable of examining it instead of assuming the two effects simply add together.

replicates

Replicates repeat the experimental treatment on appropriate independent experimental units or runs; multiple readings within one run do not automatically provide them.

Dae: Repeated readings help describe that run, but they are not automatically independent replicates. The plan must distinguish within-run readings from independently repeated runs.

design matrix

The design matrix identifies the planned combinations of factor settings; it exposes missing combinations needed for the intended comparison.

Dae: Exactly. The design matrix should show the combinations needed to address our question, rather than only the two configurations that happened to be available.

response variable

The response variable is the measured outcome of the experiment, with its location, timing, and calculation defined so results are comparable.

Dae: We need a precise response variable. Otherwise the runs might use different summaries while the slide presents them as one measure.

randomization

Randomization varies the allocation or order to reduce systematic association with uncontrolled effects; practical restrictions must be handled explicitly in the design.

Dae: That may confound design with time. Consider appropriate randomization or a justified restricted design, while preserving the applicable safety and test controls.

Read the phrases aloud. Then complete the conversation on the following pages using the word bank.

Conversation

Two settings changed, so which one improved the result?

One bench run uses fan setting A and vent X; another uses fan B and vent Y. The second records a lower temperature, but ambient conditions also differ. The team discusses a follow-up design, not authorized test settings or a release decision.

Complete the numbered gaps. Use each bank entry once; some entries contain several words.

WORD AND PHRASE BANK

replicates / design matrix / response variable / factors / interaction / randomization

- 01 **Harper:** The second prototype ran cooler. Can we say vent design Y is responsible and recommend it to the design review?
- 02 **Dae:** Not from these two runs. We changed two ¹ _____ together, and the ambient temperature was different as well.
- 03 **Harper:** Then the fan setting could explain some of the difference. We have not tested A with Y or B with X.
- 04 **Dae:** Exactly. The ² _____ should show the combinations needed to address our question, rather than only the two configurations that happened to be available.
- 05 **Harper:** Would looking at both factors together help us see whether the effect of the vent depends on the fan setting?
- 06 **Dae:** Yes. That is an ³ _____ question. We should choose a reviewed design capable of examining it instead of assuming the two effects simply add together.
- 07 **Harper:** We also need to define cooler. Are we comparing the same sensor location, the same elapsed point, and the same summary of the temperature data?
- 08 **Dae:** We need a precise ⁴ _____. Otherwise the runs might use different summaries while the slide presents them as one measure.
- 09 **Harper:** The team suggests taking several readings from the same run and treating them as several independent tests. That would give us a larger count.
- 10 **Dae:** Repeated readings help describe that run, but they are not automatically independent ⁵ _____. The plan must distinguish within-run readings from independently repeated runs.

Conversation continues on the next page.

Two settings changed, so which one improved the result?

CONVERSATION / CONTINUED

- 11 **Harper:** How should we handle changing ambient conditions? We cannot assume the laboratory stays identical throughout the work.
- 12 **Dae:** Record the relevant conditions and consider them in the design. Depending on the constraints, blocking may help account for known variation rather than let it follow one design option systematically.
- 13 **Harper:** Could we run all X configurations first and all Y configurations afterward to make setup easier?
- 14 **Dae:** That may confound design with time. Consider appropriate ⁶ _____ or a justified restricted design, while preserving the applicable safety and test controls.
- 15 **Harper:** I will not prescribe the run order in the review meeting. Please bring a plan showing the comparisons, repeated runs, and practical constraints.
- 16 **Dae:** I will also show what conclusions the proposed design can and cannot support. A limited pilot may identify a useful direction without establishing every operating condition.
- 17 **Harper:** For the existing result, we can say the B-and-Y run recorded a lower temperature under its stated conditions. We cannot assign that difference solely to the vent.
- 18 **Dae:** Correct. Preserve both runs and the ambient data. The first comparison is informative, but its limitations need to travel with the result.
- 19 **Harper:** Once the plan is reviewed, we can decide the work and resources. Until then, this discussion should not be read as permission to change the bench procedure.
- 20 **Dae:** Agreed. We are defining a better question and evidence plan, not converting an uncontrolled comparison into an approved design choice.

CHECK THE GAPS

1. factors / 2. design matrix / 3. interaction / 4. response variable / 5. replicates / 6. randomization

[Why these answers fit, page 168](#)

Repeated readings are counted as independent trials

One prototype undergoes one test run. Ten sensor readings from that run are described as ten independent trials.

Complete the exchange using each phrase once. Read both roles, then switch roles and repeat with the bank covered.

WORD AND PHRASE BANK

variation / supports / trials / count

- 01 **Lead:** Ten readings from one run are not automatically ten independent ¹ _____.
- 02 **Engineer:** Identify the experimental unit and the source of ² _____.
- 03 **Lead:** Keep the measurement count distinct from the run ³ _____.
- 04 **Engineer:** Limit the conclusion to what the design actually ⁴ _____.

CHECK THE GAPS

1. trials / 2. variation / 3. count / 4. supports

[Why these answers fit, page 168](#)

Keep the distinction audible

Negotiate an experiment that separates factors and measures variation without overstating a pilot result.

01 / Answers and explanations

A / Read the situation

A1. What is included in the proposed mass limit?

B. The empty enclosure, cover, and fasteners

The briefing explicitly includes the enclosure, cover, and fasteners while excluding electronics.

[Return to the exercise, page 4](#)

A2. What is the status of five years?

D. A proposed service-life target

Five years is proposed while conditions and the verification method remain unresolved.

[Return to the exercise, page 4](#)

A3. Which condition is still open?

A. Operating temperature

Operating temperature is listed among the unresolved conditions needed to define the proposal.

[Return to the exercise, page 4](#)

D / Response choices

D1. Which statement accurately records the mass proposal?

D. Maximum 1.2 kg for the empty enclosure including cover and fasteners, excluding electronics

The complete boundary prevents different teams from weighing different assemblies against the same number.

[Return to the exercise, page 8](#)

D2. Which sentence avoids overstating durability?

A. Five years is the proposed service life; operating conditions and verification remain open.

The proposed duration is not evidence of achieved life under unspecified conditions.

[Return to the exercise, page 8](#)

01 / Answers and explanations / continued

D3. A colleague needs the term for this meaning: The planned allocation of allowable mass. Which term fits?

C. mass budget

A Not here. derived requirement: A requirement developed from higher-level needs or analysis. The usual combination is "justify a derived requirement".

B Not here. baseline: An approved reference placed under change control. The usual combination is "establish a baseline".

C Correct. mass budget: The planned allocation of allowable mass. The usual combination is "allocate the mass budget".

D Not here. duty cycle: The pattern of operation and rest over time. The usual combination is "specify the duty cycle".

[Return to the exercise, page 8](#)

D4. Rebuild the exchange from "Lightweight compared with what?". Julia: "For durability, our commercial team has suggested five years. They have not told us the expected operating temperature or how often the unit will be handled." Wei: [missing response] Julia: "Could we leave the conditions to the design team? I do not want to slow the project by asking the customer for every detail immediately." Which response belongs in the gap?

B. Five years is a proposed service life, not yet a demonstrated result. We need the use conditions before selecting evidence that could support the requirement.

A Not here. This line belongs to turn 2, after Julia says: "We need the new enclosure to be lightweight and durable. The previous proposal felt too heavy, but our brief does not yet give a numerical limit." It addresses that point, not the missing turn in the supplied exchange.

B Correct. This is Wei's response in turn 6. It connects Julia's preceding point with Julia's follow-up. Service life is the intended period of use under specified conditions, which are still incomplete here.

C Not here. This line belongs to turn 12, after Julia says: "Once the conditions are clear, I assume we will need a way to show that the proposal has been met, not just a convincing description." It addresses that point, not the missing turn in the supplied exchange.

D Not here. This line belongs to turn 18, after Julia says: "I will send the customer the proposed boundary and the missing questions. Please do not label the specification approved until their review is complete." It addresses that point, not the missing turn in the supplied exchange.

[Return to the exercise, page 8](#)

E / Conversation

1. maximum mass

Turn 2. Maximum mass states the upper limit, unlike an undefined preference for a lightweight product.

01 / Answers and explanations / continued

2. system boundary

Turn 4. The system boundary identifies which physical items count toward the proposed mass limit.

3. service life

Turn 6. Service life is the intended period of use under specified conditions, which are still incomplete here.

4. operating envelope

Turn 8. The operating envelope defines the conditions under which the design is expected to operate.

5. assumption register

Turn 10. An assumption register preserves unconfirmed premises and their ownership until they are resolved.

6. verification method

Turn 12. The verification method specifies how evidence will be obtained to check the requirement.

7. rationale

Turn 14. The rationale records why the requirement exists and supports later review of changes.

8. traceability

Turn 16. Traceability links the customer need, requirement, and later evidence without pretending unfinished items are complete.

9. baseline

Turn 18. A baseline is an approved reference, not merely the latest proposal discussed at a meeting.

10. requirement owner

Turn 20. The requirement owner is responsible for maintaining the requirement and coordinating resolution of its open details.

[Return to the conversation, page 10](#)

F / Accuracy and scope

F1. What should happen to unresolved environmental assumptions?

C. Record them with owners for confirmation.

Recording ownership preserves uncertainty and provides a route to resolve the missing inputs.

[Return to the exercise, page 12](#)

01 / Answers and explanations / continued

F2. A prototype meets the proposed mass boundary at 1.15 kg. What does that establish about the five-year target?

C. Nothing by itself; a mass result does not demonstrate service life under undefined conditions.

Mass and durability are different properties with separate boundaries and evidence needs. The mass comparison does not resolve life, conditions, or approval.

[Return to the exercise, page 12](#)

F / Guided speaking

1. included

Engineer: The lid and screws are included.

Turn 1. The supplied boundary explicitly counts the housing, lid, and screws.

2. excluded

Customer: The batteries are excluded.

Turn 2. Batteries are explicitly outside the proposed mass boundary in this case.

3. unresolved

Engineer: Humidity remains unresolved.

Turn 3. The briefing states that operating humidity has not yet been agreed.

4. baseline

Customer: This is a proposal, not an approved baseline.

Turn 4. Approval is pending, so the proposal is not an approved reference.

[Return to the conversation, page 13](#)

01 / Answers and explanations / continued

F / Rebuild the exchange

1. Rebuild the exchange from "Lightweight compared with what?". Julia: "I also want the specification to preserve why we chose the limit. A later reviewer may otherwise change it without understanding the installation problem behind it." Wei: [missing response] Julia: "Let us send the precise mass proposal now and mark the environmental questions as open. I do not want the clear mass limit to make the whole specification look settled." Which response belongs in the gap?

A. Keep the rationale with the requirement. That helps reviewers assess whether a proposed change still serves the customer need instead of debating the number in isolation.

A Correct. This is Wei's response in turn 14. It connects Julia's preceding point with Julia's follow-up. The rationale records why the requirement exists and supports later review of changes.

B Not here. This line belongs to turn 4, after Julia says: "Use that value for discussion. I mean the empty enclosure with its cover and fasteners, not the electronics that our team will install later." It addresses that point, not the missing turn in the supplied exchange.

C Not here. This line belongs to turn 10, after Julia says: "I will ask about temperature, humidity, and handling. Some units may move between workstations, so we should not assume they all stay fixed in one installation." It addresses that point, not the missing turn in the supplied exchange.

D Not here. This line belongs to turn 8, after Julia says: "Could we leave the conditions to the design team? I do not want to slow the project by asking the customer for every detail immediately." It addresses that point, not the missing turn in the supplied exchange.

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02 / Answers and explanations

A / Read the situation

A1. What does the CAD model currently show?

C. 2 mm nominal clearance

The model supplies nominal geometry but not the missing tolerance evidence.

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A2. What does R-14 require?

A. At least 1 mm across approved dimensional tolerances

The stated requirement applies across tolerances, not only at nominal dimensions.

[Return to the exercise, page 14](#)

A3. What is not established?

A. Whether the minimum clearance meets R-14

Without the stack-up and confirmed revision, compliance with the minimum remains unverified.

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D / Response choices

D1. Which review comment is best supported?

D. R-14 remains unverified pending the stack-up and revision confirmation.

This comment identifies the evidence gap without converting uncertainty into failure or compliance.

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D2. Which closure action addresses both missing inputs for R-14?

A. Confirm the supplier drawing revision and review the interface tolerance stack-up against the 1 mm minimum.

The open item concerns combined allowed variation on an identified configuration. Repeating nominal geometry, checking a filename alone, or recording attendance does not resolve it.

[Return to the exercise, page 18](#)

02 / Answers and explanations / continued

D3. A colleague needs the term for this meaning: The space between adjacent parts. Which term fits?

A. clearance

A Correct. clearance: The space between adjacent parts. The usual combination is "verify minimum clearance".

B Not here. conditional approval: Approval explicitly subject to specified conditions, where allowed. The usual combination is "document conditional approval".

C Not here. closure evidence: Information demonstrating that an open item is resolved. The usual combination is "attach closure evidence".

D Not here. datum: A reference used to establish dimensional relationships. The usual combination is "identify the datum".

[Return to the exercise, page 18](#)

D4. Rebuild the exchange from "The drawing fits; the evidence is missing". Ahmed: "That is a fair distinction. The model also came from the supplier file, but I cannot confirm which drawing issue was used without checking our records." Clara: [missing response] Ahmed: "Please replace check fit with the actual task: confirm the supplier revision and assess minimum clearance against R-14. I can own that analysis." Which response belongs in the gap?

B. Confirm the drawing revision before completing the calculation. An analysis of an obsolete interface could look convincing while answering the wrong configuration question.

A Not here. This line belongs to turn 16, after Ahmed says: "That is a concern I can answer. Keep the comment tied to the missing stack-up and revision, so the team knows exactly what needs closing." It addresses that point, not the missing turn in the supplied exchange.

B Correct. This is Clara's response in turn 6. It connects Ahmed's preceding point with Ahmed's follow-up. The drawing revision identifies the supplier geometry and tolerances that the analysis must actually evaluate.

C Not here. This line belongs to turn 2, after Ahmed says: "The model shows a two-millimeter gap, and the chair wants to recommend release today. Do you have a specific concern, or can we close the review?" It addresses that point, not the missing turn in the supplied exchange.

D Not here. This line belongs to turn 4, after Ahmed says: "The nominal geometry is comfortably above one millimeter. I agree that it does not show every combination, but I do not want the team to hear that the design has failed." It addresses that point, not the missing turn in the supplied exchange.

[Return to the exercise, page 18](#)

E / Conversation

1. tolerance stack-up

Turn 2. The tolerance stack-up evaluates combined dimensional variation rather than relying on the nominal CAD gap.

02 / Answers and explanations / continued

2. Nominal clearance

Turn 4. Nominal clearance describes the reference geometry; it does not establish the smallest gap across allowed variation.

3. drawing revision

Turn 6. The drawing revision identifies the supplier geometry and tolerances that the analysis must actually evaluate.

4. review action

Turn 8. A review action assigns a specific task arising from the meeting, rather than leaving an unowned concern.

5. closure evidence

Turn 10. Closure evidence must show that the specific requirement gap has been resolved on the confirmed configuration.

6. Conditional approval

Turn 12. Conditional approval must follow the applicable process and state its limits; it cannot silently mean unrestricted release.

7. release authority

Turn 14. The release authority is the role permitted to make the release decision, distinct from individual reviewers.

8. technical objection

Turn 16. A technical objection challenges a defined claim with reasons and a route to resolution, not a colleague's competence.

9. open item

Turn 18. An open item records the unresolved matter until the stated closure conditions are satisfied.

10. Action closure

Turn 20. Action closure requires verified resolution of the assigned task, not simply an intention to provide evidence later.

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02 / Answers and explanations / continued

F / Accuracy and scope

F1. What may the minutes record now?

C. An open verification item and its assigned follow-up

The current record supports a pending item, not an invented approval, failure, or agreement.

[Return to the exercise, page 22](#)

F2. What would justify closing the item?

D. Reviewed evidence for the confirmed configuration against R-14

Closure must resolve the specific requirement and configuration gap identified in the review.

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F / Guided speaking

1. nominal

Reviewer: Three millimeters is the nominal clearance.

Turn 1. The value comes from reference geometry, not a completed variation analysis.

2. confirmation

Engineer: The supplier revision needs confirmation.

Turn 2. The briefing explicitly says the supplier revision has not been confirmed.

3. unverified

Reviewer: The minimum remains unverified.

Turn 3. A missing stack-up prevents verification of the required minimum across tolerances.

4. evidence

Engineer: The item closes with reviewed evidence.

Turn 4. Closure needs evidence addressing the requirement, not merely a repeated nominal value.

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02 / Answers and explanations / continued

F / Rebuild the exchange

1. Rebuild the exchange from "The drawing fits; the evidence is missing". Ahmed: "I will ask the chair to separate any permitted preparatory work from release. We should not imply that every downstream activity has the same dependency." Clara: [missing response] Ahmed: "That is a concern I can answer. Keep the comment tied to the missing stack-up and revision, so the team knows exactly what needs closing." Which response belongs in the gap?

A. Agreed. Identify the release authority and let that role decide on the recorded basis. My review comment should not be mistaken for unilateral approval or rejection.

A Correct. This is Clara's response in turn 14. It connects Ahmed's preceding point with Ahmed's follow-up. The release authority is the role permitted to make the release decision, distinct from individual reviewers.

B Not here. This line belongs to turn 8, after Ahmed says: "Please replace check fit with the actual task: confirm the supplier revision and assess minimum clearance against R-14. I can own that analysis." It addresses that point, not the missing turn in the supplied exchange.

C Not here. This line belongs to turn 18, after Ahmed says: "I will revise the minutes to keep the interface item open. The release recommendation will remain unresolved until the evidence and required review are available." It addresses that point, not the missing turn in the supplied exchange.

D Not here. This line belongs to turn 10, after Ahmed says: "I can own the analysis. I will identify the confirmed supplier revision, state the tolerance assumptions, and present the resulting minimum against R-14." It addresses that point, not the missing turn in the supplied exchange.

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03 / Answers and explanations

A / Read the situation

A1. What was directly observed?

D. S7 stopped producing an output at minute 46.

The briefing gives an output interruption on one identified sample, not a confirmed explanation.

[Return to the exercise, page 26](#)

A2. Which statement accurately describes the cause?

B. Connector damage is an unconfirmed hypothesis.

Neither reproduction nor setup checks have established the cause of the event.

[Return to the exercise, page 26](#)

A3. What cannot be calculated from the supplied facts alone?

C. A representative population failure rate

A single reported event without an adequate exposure and sampling basis does not establish population reliability.

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D / Response choices

D1. Which draft sentence should replace "connector damage caused the failure"?

B. S7 lost output at minute 46; connector damage remains a hypothesis.

The replacement preserves the observation while accurately qualifying the unconfirmed cause.

[Return to the exercise, page 30](#)

D2. Why preserve the event log and sample identity?

B. They connect the investigation to the actual event and configuration.

Traceable records let investigators evaluate the event without inventing a causal conclusion.

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03 / Answers and explanations / continued

D3. A colleague needs the term for this meaning: An underlying cause supported by an appropriate investigation. Which term fits?

A. root cause

A Correct. root cause: An underlying cause supported by an appropriate investigation. The usual combination is "establish the root cause".

B Not here. repeatability: Agreement of repeated measurements under the same stated conditions. The usual combination is "check repeatability".

C Not here. severity: The seriousness of a stated consequence. The usual combination is "assess severity".

D Not here. event log: A time-ordered record of system or test events. The usual combination is "export the event log".

[Return to the exercise, page 30](#)

D4. Rebuild the exchange from "One interruption, several possible explanations".

Grace: "The setup checks are still open too. Can we examine the fixture and connection without treating either as the explanation before we have the evidence?"

Pavel: [missing response] **Grace:** "I have S7's identifier, the event time, and the configuration details. What other original records should I attach before the team starts the investigation?" Which response belongs in the gap?

D. Review the test setup under the approved process. That is part of interpreting the event, not a reason to dismiss the sample interruption as inconvenient.

A Not here. This line belongs to turn 8, after Grace says: "I have S7's identifier, the event time, and the configuration details. What other original records should I attach before the team starts the investigation?" It addresses that point, not the missing turn in the supplied exchange.

B Not here. This line belongs to turn 2, after Grace says: "S7 stopped producing an output at minute forty-six of the planned hour. The draft report says connector damage caused the failure, but we have not examined that explanation yet." It addresses that point, not the missing turn in the supplied exchange.

C Not here. This line belongs to turn 4, after Grace says: "The team has seen similar symptoms before, which is why the explanation sounds persuasive. I do not want to ignore their experience, but this event has not been reproduced." It addresses that point, not the missing turn in the supplied exchange.

D Correct. This is Pavel's response in turn 6. It connects Grace's preceding point with Grace's follow-up. The test setup includes the fixture and connections whose condition may affect interpretation of the sample result.

[Return to the exercise, page 30](#)

03 / Answers and explanations / continued

E / Conversation

1. failure mode

Turn 2. The failure mode is loss of output, the observed way the sample stopped meeting its intended function.

2. hypothesis

Turn 4. A hypothesis is a plausible explanation to investigate, not an established finding based on this event.

3. test setup

Turn 6. The test setup includes the fixture and connections whose condition may affect interpretation of the sample result.

4. event log

Turn 8. The event log retains time-ordered evidence connecting the observed interruption to the test and sample.

5. residual uncertainty

Turn 10. Residual uncertainty includes the unresolved cause and the limits on any population-level reliability claim.

6. failure effect

Turn 12. The failure effect is the consequence of the mode at a stated level, distinct from the mechanism causing it.

7. FMEA

Turn 14. FMEA connects possible failure modes, their effects, causes, and controls without converting hypotheses into proven causes.

8. containment

Turn 16. Containment limits immediate exposure while the underlying cause and permanent response may still be unresolved.

9. corrective action

Turn 18. Corrective action addresses an established cause and requires appropriate evidence that the intended correction works.

03 / Answers and explanations / continued

10. failure analysis

Turn 20. Failure analysis systematically evaluates the preserved evidence and possible explanations rather than endorsing the first plausible story.

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F / Accuracy and scope

F1. A later repeat run shows no interruption. What should happen to the original S7 result?

C. Retain the minute-46 event and investigate why the observations differ; one repeat does not identify the cause.

A non-recurrence in a later run does not erase the original observation or distinguish the connector, fixture, setup, and other possible explanations.

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F2. Which wording distinguishes containment from corrective action?

B. Exposure controls may begin while the cause-based action remains undecided.

Immediate exposure management and action against an established cause have different purposes.

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F / Guided speaking

1. mode

Tester: Loss of signal is the observed failure mode.

Turn 1. The mode describes how the required function failed, not why it failed.

2. hypothesis

Engineer: Cable damage is still a hypothesis.

Turn 2. The suspected explanation has not been confirmed by the stated checks.

3. log

Tester: We will preserve the original log.

Turn 3. The available original log is relevant evidence for the recorded event.

4. unresolved

Engineer: The root cause remains unresolved.

Turn 4. Neither the cable nor the fixture has been checked, so the cause is not established.

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03 / Answers and explanations / continued

F / Rebuild the exchange

1. Rebuild the exchange from "One interruption, several possible explanations".

Grace: "Would it be useful to record the possible mode and causes in the structured review now, even while the evidence remains incomplete?" Pavel: [missing response]

Grace: "We may need an immediate restriction while the investigation continues. I want to avoid calling that restriction a permanent fix in the status update." Which response belongs in the gap?

A. Yes, update the FMEA where appropriate, with the uncertainty visible. Its entries should support investigation and control decisions, not give an unsupported explanation the appearance of formal proof.

A Correct. This is Pavel's response in turn 14. It connects Grace's preceding point with Grace's follow-up. FMEA connects possible failure modes, their effects, causes, and controls without converting hypotheses into proven causes.

B Not here. This line belongs to turn 10, after Grace says: "The manager asked whether one failure means the whole population is unreliable. I can report this event, but we do not have the information for that broader conclusion." It addresses that point, not the missing turn in the supplied exchange.

C Not here. This line belongs to turn 16, after Grace says: "We may need an immediate restriction while the investigation continues. I want to avoid calling that restriction a permanent fix in the status update." It addresses that point, not the missing turn in the supplied exchange.

D Not here. This line belongs to turn 2, after Grace says: "S7 stopped producing an output at minute forty-six of the planned hour. The draft report says connector damage caused the failure, but we have not examined that explanation yet." It addresses that point, not the missing turn in the supplied exchange.

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04 / Answers and explanations

A / Read the situation

A1. Which result is supported?

C. All three prototypes met the stated bench criterion at 20 degrees Celsius.

Each recorded maximum is below 200 milliseconds, but the conditions and sample are limited.

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A2. Which value was the largest recorded maximum?

C. 175 milliseconds

The three recorded maxima are 150, 160, and 175 milliseconds.

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A3. What remains untested in this case?

C. Performance at the other temperatures in the intended range

Only 20 degrees Celsius was tested; the remaining intended temperatures were not covered.

[Return to the exercise, page 39](#)

D / Response choices

D1. Which presentation headline is most accurate?

D. Three revision-B prototypes met the response-time criterion in the stated bench test.

The headline reports the demonstrated sample result without extending it to untested conditions or units.

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D2. What does the observed 100% pass fraction mean?

A. All three tested items met this criterion in this test.

A sample pass fraction describes these observations and does not establish universal reliability.

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04 / Answers and explanations / continued

D3. A colleague needs the term for this meaning: The number of items or observations in a stated sample. Which term fits?

B. sample size

A Not here. test duration: The length of time a test runs. The usual combination is "state the test duration".

B Correct. sample size: The number of items or observations in a stated sample. The usual combination is "report the sample size".

C Not here. instrument calibration: Establishing the relation between instrument indications and reference values. The usual combination is "check instrument calibration".

D Not here. representativeness: How well a sample or condition reflects the target use or population. The usual combination is "assess representativeness".

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D4. Rebuild the exchange from "Three passes do not mean every condition". Amina: "The recorded maximum response times were one hundred fifty, one hundred sixty, and one hundred seventy-five milliseconds. The criterion allowed up to two hundred milliseconds." Ben: [missing response] Amina: "I will write three out of three met the criterion. That is clearer than a large one-hundred-percent headline with the sample size hidden below it." Which response belongs in the gap?

D. Then the largest observed maximum was one hundred seventy-five. That is twenty-five milliseconds below the criterion, but it is not a universal product limit.

A Not here. This line belongs to turn 16, after Amina says: "What should I say if someone asks about ten and forty degrees? We have no supporting model or test at those temperatures in this package." It addresses that point, not the missing turn in the supplied exchange.

B Not here. This line belongs to turn 8, after Amina says: "I will write three out of three met the criterion. That is clearer than a large one-hundred-percent headline with the sample size hidden below it." It addresses that point, not the missing turn in the supplied exchange.

C Not here. This line belongs to turn 10, after Amina says: "The intended operating range is ten to forty degrees. Since we tested only twenty, the other temperatures remain a gap rather than a demonstrated pass." It addresses that point, not the missing turn in the supplied exchange.

D Correct. This is Ben's response in turn 6. It connects Amina's preceding point with Amina's follow-up. The observed maximum is the largest recorded value, not a guaranteed limit for every future unit or condition.

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E / Conversation

1. pass fraction

Turn 2. The pass fraction is three passing prototypes out of three tested, limited to this criterion and test.

04 / Answers and explanations / continued

2. test conditions

Turn 4. Test conditions specify the temperature, duration, and procedure under which the observations were obtained.

3. observed maximum

Turn 6. The observed maximum is the largest recorded value, not a guaranteed limit for every future unit or condition.

4. sample size

Turn 8. Sample size identifies the three prototypes behind the percentage and prevents an impression of broader evidence.

5. test coverage

Turn 10. Test coverage describes which requirements and conditions were actually addressed, exposing the untested temperature range.

6. verification

Turn 12. Verification checks a specified requirement; this bench result does not by itself establish complete intended-use suitability.

7. validation

Turn 14. Validation addresses intended-use needs, which are broader than the single bench criterion described here.

8. extrapolation

Turn 16. Extrapolation extends conclusions beyond the observed temperature; no supporting model or additional evidence is supplied here.

9. reliability claim

Turn 18. A reliability claim requires a defined performance, time, conditions, and supporting basis beyond a small unqualified pass count.

10. evidence boundary

Turn 20. The evidence boundary separates the supported bench result from broader claims about other conditions, units, or lifetime.

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04 / Answers and explanations / continued

F / Accuracy and scope

F1. The largest recorded maximum is 175 ms against a 200 ms limit. Which statement is precise?

A. The observed gap to the limit is 25 ms; no supplied uncertainty budget establishes a guaranteed margin for all units.

Subtraction gives 25 milliseconds for the reported result. That arithmetic does not extend the sample, cover other temperatures, or supply a measurement-uncertainty assessment.

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F2. Which limitation is specific and useful?

C. Performance at the other intended temperatures was not tested.

This identifies the missing coverage without denying the observed passes or inventing failures.

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F / Guided speaking

1. four

Engineer: The tested sample size was four.

Turn 1. The briefing identifies four prototypes in this particular bench test.

2. hours

Reviewer: The duration was three hours.

Turn 2. The supplied test duration is three hours, not a service-life result.

3. untested

Engineer: The other temperatures remain untested.

Turn 3. The briefing explicitly excludes testing at the other intended temperatures.

4. reliability

Reviewer: The result does not establish population reliability.

Turn 4. No population reliability estimate or adequate supporting basis is supplied.

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04 / Answers and explanations / continued

F / Rebuild the exchange

1. Rebuild the exchange from "Three passes do not mean every condition". Amina: "The slide also calls the product fully validated. We have not supplied evidence for the complete use context, so that phrase creates a second overclaim." Ben: [missing response] Amina: "What should I say if someone asks about ten and forty degrees? We have no supporting model or test at those temperatures in this package." Which response belongs in the gap?

D. Remove the unsupported validation claim. We can explain what has been demonstrated and which intended-use evidence remains outstanding without making the result sound like a failure.

A Not here. This line belongs to turn 4, after Amina says: "Let us put the actual conditions beside the result. These were revision-B prototypes, tested for two hours at twenty degrees Celsius under the bench procedure." It addresses that point, not the missing turn in the supplied exchange.

B Not here. This line belongs to turn 18, after Amina says: "I will also avoid adding a confidence percentage. The supplied records do not include a statistical sampling plan, uncertainty budget, or lifetime analysis." It addresses that point, not the missing turn in the supplied exchange.

C Not here. This line belongs to turn 8, after Amina says: "I will write three out of three met the criterion. That is clearer than a large one-hundred-percent headline with the sample size hidden below it." It addresses that point, not the missing turn in the supplied exchange.

D Correct. This is Ben's response in turn 14. It connects Amina's preceding point with Amina's follow-up. Validation addresses intended-use needs, which are broader than the single bench criterion described here.

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05 / Answers and explanations

A / Read the situation

A1. What is the recurring material-plus-assembly cost of A?

D. \$14 per unit

Adding A's stated material cost of eight dollars and assembly cost of six gives fourteen.

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A2. What is the total stated cost of B for 3,000 units?

D. \$41,000

Three thousand units at twelve dollars cost thirty-six thousand, plus five thousand in tooling.

[Return to the exercise, page 52](#)

A3. What remains unresolved after the calculation?

D. Technical suitability, capacity, and approval

The briefing explicitly leaves technical and supply decisions open despite the available cost figures.

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D / Response choices

D1. Which recommendation is supported at 3,000 units?

B. B has the lower stated cost, subject to unresolved technical and capacity reviews.

B's total is two thousand dollars lower, but cost arithmetic does not resolve the other reviews.

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D2. At which volume are the stated totals equal?

C. 2,000 units

B's additional four-thousand-dollar tooling cost is offset by two dollars per unit at two thousand units.

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05 / Answers and explanations / continued

D3. A colleague needs the term for this meaning: The structured list of parts and materials in a product, abbreviated BOM. Which term fits?

B. bill of materials

A Not here. tooling investment: Expenditure on equipment or tools needed for production. The usual combination is "justify tooling investment".

B Correct. bill of materials: The structured list of parts and materials in a product, abbreviated BOM. The usual combination is "compare the bill of materials".

C Not here. incremental cost: The change in cost between specified alternatives. The usual combination is "compare incremental cost".

D Not here. yield assumption: The assumed proportion of production meeting a defined criterion. The usual combination is "challenge the yield assumption".

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D4. Rebuild the exchange from "Cheaper material, more expensive assembly". Tessa: "Two dollars times three thousand gives six thousand saved. Should I put six thousand as the overall saving on the slide?" Arun: [missing response] Tessa: "Let me check the totals: A is forty-two thousand plus one thousand, and B is thirty-six thousand plus five thousand. Forty-three versus forty-one thousand." Which response belongs in the gap?

D. Not yet. B's tooling investment is five thousand against A's one thousand. Subtract that additional four thousand from the recurring saving; the overall difference is two thousand.

A Not here. This line belongs to turn 2, after Tessa says: "The slide recommends A because its material costs eight dollars per unit instead of ten. I have not included assembly or tooling in that recommendation yet." It addresses that point, not the missing turn in the supplied exchange.

B Not here. This line belongs to turn 10, after Tessa says: "The extra tooling is four thousand and the recurring difference is two per unit. Dividing gives two thousand units. Is that where the costs are equal?" It addresses that point, not the missing turn in the supplied exchange.

C Not here. This line belongs to turn 20, after Tessa says: "I will revise the slide: B is two thousand lower at three thousand units on the stated basis, pending suitability, capacity, and approval. No purchase is authorized." It addresses that point, not the missing turn in the supplied exchange.

D Correct. This is Arun's response in turn 6. It connects Tessa's preceding point with Tessa's follow-up. Tooling investment is the one-time amount added to the recurring production total for each option.

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E / Conversation

1. cost model

Turn 2. The cost model combines the same cost categories and quantity for both alternatives rather than comparing material alone.

05 / Answers and explanations / continued

2. recurring cost

Turn 4. Recurring cost is the material-plus-assembly amount incurred for each unit, excluding the one-time tooling.

3. tooling investment

Turn 6. Tooling investment is the one-time amount added to the recurring production total for each option.

4. production volume

Turn 8. Production volume is the three-thousand-unit basis that determines how recurring savings compare with fixed tooling differences.

5. break-even volume

Turn 10. Break-even volume is two thousand units because the two-dollar saving offsets four thousand dollars of additional tooling.

6. cost trade-off

Turn 12. The cost trade-off exchanges higher upfront tooling for lower recurring assembly-inclusive cost.

7. manufacturability

Turn 14. Manufacturability concerns producing the design by the intended process; a lower calculated price does not establish it.

8. process capability

Turn 16. Process capability concerns meeting specified limits in a stable process and is distinct from a quoted cost or available capacity.

9. yield assumption

Turn 18. The yield assumption is the no-scrap premise used here; different actual yields could change acceptable-unit cost.

10. unit cost

Turn 20. Unit cost must identify included categories and volume; otherwise recurring-only and tooling-inclusive figures can be confused.

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05 / Answers and explanations / continued

F / Accuracy and scope

F1. B saves \$2 per unit for 3,000 units. Why is the stated total saving \$2,000 rather than \$6,000?

A. The \$6,000 recurring saving is offset by B's \$4,000 additional tooling.

Recurring savings are 3,000 times \$2. Tooling differs by \$5,000 minus \$1,000, so the net difference is \$6,000 minus \$4,000 = \$2,000.

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F2. Why should the model state no scrap?

B. Different production yields could change the cost comparison.

A stated simplification is needed because actual losses may alter the cost of acceptable output.

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F / Guided speaking

1. 11000

Engineer: C totals 11000 dollars.

Turn 1. Nine dollars times one thousand units plus two thousand tooling equals eleven thousand.

2. 13000

Reviewer: D totals 13000 dollars.

Turn 2. Seven dollars times one thousand units plus six thousand tooling equals thirteen thousand.

3. C

Engineer: At this quantity, the lower-cost option is C.

Turn 3. C costs eleven thousand, which is two thousand less than D.

4. 2000

Reviewer: Equal totals occur at 2000 units.

Turn 4. D's four-thousand-dollar additional tooling is offset by two dollars per unit at two thousand.

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05 / Answers and explanations / continued

F / Rebuild the exchange

1. Rebuild the exchange from "Cheaper material, more expensive assembly". Tessa: "Can we recommend buying B now that it wins this calculation? Its assembly estimate is attractive, but technical suitability has not been reviewed." Arun: [missing response] Tessa: "I also need the supplier's capacity confirmation. Having enough machines available would answer volume, but not necessarily whether the parts meet dimensional limits." Which response belongs in the gap?

D. No. Its manufacturability is still unresolved. The cost sheet does not show that the proposed process can produce a housing meeting the design requirements.

A Not here. This line belongs to turn 18, after Tessa says: "We assumed every produced unit is acceptable. I will state that clearly, rather than present the model as though we measured the supplier's losses." It addresses that point, not the missing turn in the supplied exchange.

B Not here. This line belongs to turn 8, after Tessa says: "Let me check the totals: A is forty-two thousand plus one thousand, and B is thirty-six thousand plus five thousand. Forty-three versus forty-one thousand." It addresses that point, not the missing turn in the supplied exchange.

C Not here. This line belongs to turn 12, after Tessa says: "At only one thousand units, A becomes fifteen thousand and B seventeen thousand. So saying B is always cheaper would also be wrong." It addresses that point, not the missing turn in the supplied exchange.

D Correct. This is Arun's response in turn 14. It connects Tessa's preceding point with Tessa's follow-up. Manufacturability concerns producing the design by the intended process; a lower calculated price does not establish it.

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06 / Answers and explanations

A / Read the situation

A1. What does 2.0 describe in the note?

A. A preliminary static-model ratio under its stated convention

The ratio belongs to the preliminary static model and does not establish the broader claims.

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A2. Which behavior is outside the model's assessment?

C. Fatigue and dynamic-loading effects

The briefing explicitly places fatigue and dynamic loading outside the model.

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A3. What is missing from the compliance claim?

A. The applicable requirement and acceptance threshold

A compliance conclusion needs an identified basis, which the note currently does not provide.

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D / Response choices

D1. Which replacement note is justified?

D. The preliminary static model reports 2.0; applicable acceptance requirements and review remain unresolved.

The replacement preserves the numerical result and clearly identifies the missing decision basis.

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D2. Why is the applicable requirement necessary?

A. It establishes what must be assessed and the acceptance basis.

Without the governing requirement, the ratio cannot be judged against the correct acceptance conditions.

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06 / Answers and explanations / continued

D3. A colleague needs the term for this meaning: A defined combination of actions considered in an analysis. Which term fits?

B. load case

A Not here. applicable requirement: A requirement that governs the specific product or situation. The usual combination is "identify applicable requirements".

B Correct. load case: A defined combination of actions considered in an analysis. The usual combination is "assess the load case".

C Not here. independent review: Review by a suitably separate qualified reviewer. The usual combination is "arrange independent review".

D Not here. yield limit: A boundary associated with the onset of specified permanent deformation. The usual combination is "identify the yield limit".

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D4. Rebuild the exchange from "A ratio is not a compliance decision". Rosa: "I will name the failure condition beside the ratio. Which inputs and assumptions must the reviewer see to understand what this particular calculation covers?" Malik: [missing response] Rosa: "Fatigue and dynamic loading were excluded. I will state that directly instead of allowing the static result to stand in for those separate questions." Which response belongs in the gap?

D. Exactly. Name the failure criterion and the relevant inputs. A ratio without that context can sound precise while leaving its actual technical meaning unclear.

A Not here. This line belongs to turn 16, after Rosa says: "We also have no formal conformity assessment recorded. I should not write as though assembling the internal note has completed whatever external or internal route applies." It addresses that point, not the missing turn in the supplied exchange.

B Not here. This line belongs to turn 12, after Rosa says: "I will check the contract requirements too. Can we identify the applicable documents and versions before the note lists standards that may not govern this product?" It addresses that point, not the missing turn in the supplied exchange.

C Not here. This line belongs to turn 4, after Rosa says: "The model uses its stated capacity-to-demand convention. It is a static assessment, but the note does not identify the required threshold or who reviewed the result." It addresses that point, not the missing turn in the supplied exchange.

D Correct. This is Malik's response in turn 6. It connects Rosa's preceding point with Rosa's follow-up. The failure criterion defines the condition against which capacity and demand are assessed.

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E / Conversation

1. applicable requirement

Turn 2. The applicable requirement defines the governing obligation and acceptance basis missing from the current note.

06 / Answers and explanations / continued

2. factor of safety

Turn 4. The factor of safety is a defined ratio in this model, not a universal measure proving complete product safety.

3. failure criterion

Turn 6. The failure criterion defines the condition against which capacity and demand are assessed.

4. analysis limitations

Turn 8. Analysis limitations identify excluded behaviors, including fatigue and dynamic loading, that the reported model cannot establish.

5. model validity

Turn 10. Model validity concerns whether the model is appropriate for the claimed assessment, beyond simply producing a numerical output.

6. standard edition

Turn 12. The standard edition identifies the specific version whose requirements are being applied, rather than assuming all versions are interchangeable.

7. compliance matrix

Turn 14. A compliance matrix connects each applicable requirement with evidence and its assessment status.

8. conformity assessment

Turn 16. Conformity assessment evaluates specified requirements through the applicable route; writing an internal note does not establish its completion.

9. authorized sign-off

Turn 18. Authorized sign-off is an actual approval by the relevant authority, which is not supplied by the preliminary calculation.

10. evidence package

Turn 20. The evidence package must support the exact claim through identified requirements, suitable analyses, limitations, and review records.

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06 / Answers and explanations / continued

F / Accuracy and scope

F1. The static factor is 2.0 and fatigue is outside the model. Which conclusion is justified?

B. Fatigue performance is not established by this model; it needs an appropriate assessment basis.

A static capacity-to-demand ratio is not a fatigue-life result. An excluded behavior is unassessed here, not automatically passed, failed, or irrelevant.

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F2. What should a compliance matrix connect?

C. Applicable requirements, evidence, and assessment status

The matrix supports traceability between the actual requirements, supporting records, and current conclusions.

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F / Guided speaking

1. static

Engineer: The reported value belongs to the static model.

Turn 1. The briefing identifies the report as a preliminary static assessment.

2. fatigue

Reviewer: The model excludes fatigue.

Turn 2. Fatigue is explicitly outside the scope of the supplied model.

3. unidentified

Engineer: The acceptance threshold remains unidentified.

Turn 3. No applicable acceptance threshold is supplied in the briefing.

4. granted

Reviewer: Release approval has not been granted.

Turn 4. The briefing states that the report has not received release approval.

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06 / Answers and explanations / continued

F / Rebuild the exchange

1. Rebuild the exchange from "A ratio is not a compliance decision". Rosa: "I can organize the record so each applicable requirement points to the analysis or test evidence and shows whether assessment is complete, open, or awaiting review." Malik: [missing response] Rosa: "We also have no formal conformity assessment recorded. I should not write as though assembling the internal note has completed whatever external or internal route applies." Which response belongs in the gap?

A. That is the purpose of a compliance matrix. It should expose the missing links rather than turn a single favorable calculation into a blanket green status.

A Correct. This is Malik's response in turn 14. It connects Rosa's preceding point with Rosa's follow-up. A compliance matrix connects each applicable requirement with evidence and its assessment status.

B Not here. This line belongs to turn 8, after Rosa says: "Fatigue and dynamic loading were excluded. I will state that directly instead of allowing the static result to stand in for those separate questions." It addresses that point, not the missing turn in the supplied exchange.

C Not here. This line belongs to turn 4, after Rosa says: "The model uses its stated capacity-to-demand convention. It is a static assessment, but the note does not identify the required threshold or who reviewed the result." It addresses that point, not the missing turn in the supplied exchange.

D Not here. This line belongs to turn 2, after Rosa says: "The note says compliant, and the preliminary analysis reports a factor of two. Before I circulate it, I want to check whether that label is justified." It addresses that point, not the missing turn in the supplied exchange.

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07 / Answers and explanations

A / Read the situation

A1. What needs correction?

A. Humidity was stated as a confirmed cause without confirmation.

The earlier email converted an unconfirmed humidity hypothesis into a causal finding.

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A2. What can Marco commit to?

A. An update by 10 a.m. on October 2

The only supplied commitment is the next update, not resolution or operating authorization.

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A3. Which statement preserves the customer's report?

D. Unit L18 has two reported output interruptions.

The two reported events remain relevant even though their cause is unresolved.

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D / Response choices

D1. Which opening best corrects the earlier message?

B. Our email overstated the cause; humidity remains unconfirmed.

The opening explicitly corrects the unsupported certainty without discarding the reported events.

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D2. Which deadline statement is supported?

A. I will send an investigation update by 10 a.m. on October 2.

Only the communication deadline is authorized by the supplied facts.

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07 / Answers and explanations / continued

D3. A colleague needs the term for this meaning: A conclusion supported by the completed relevant checks. Which term fits?

C. confirmed finding

A Not here. chain of custody: A record of possession and transfer of evidence or an item. The usual combination is "maintain chain of custody".

B Not here. unit serial number: A unique identifier for an individual product unit. The usual combination is "confirm the unit serial number".

C Correct. confirmed finding: A conclusion supported by the completed relevant checks. The usual combination is "separate confirmed findings".

D Not here. update cadence: The agreed frequency or timing of progress communication. The usual combination is "agree an update cadence".

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D4. Rebuild the exchange from "Correct the cause without losing the customer". Nia: "Should our internal summary remove humidity entirely? I want it to be accurate without hiding an explanation that your engineers are still examining." Marco: [missing response] Nia: "Please identify the earlier email in the correction. People are still forwarding it, so they need an explicit statement that the cause has not been confirmed." Which response belongs in the gap?

D. Describe it as a working hypothesis. It is one explanation being investigated, not a confirmed finding and not something we have ruled out through completed checks.

A Not here. This line belongs to turn 8, after Nia says: "Please identify the earlier email in the correction. People are still forwarding it, so they need an explicit statement that the cause has not been confirmed." It addresses that point, not the missing turn in the supplied exchange.

B Not here. This line belongs to turn 4, after Nia says: "Please keep the two interruptions in the record. Uncertainty about the explanation does not change what our operators reported or the disruption they experienced." It addresses that point, not the missing turn in the supplied exchange.

C Not here. This line belongs to turn 14, after Nia says: "What will that update contain if the cause is still open? Saying we are working on it would give us little new information." It addresses that point, not the missing turn in the supplied exchange.

D Correct. This is Marco's response in turn 6. It connects Nia's preceding point with Nia's follow-up. A working hypothesis remains under investigation without being presented as a supported causal finding.

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E / Conversation

1. causal statement

Turn 2. The causal statement claimed humidity produced the interruptions, which the available investigation has not established.

07 / Answers and explanations / continued

2. field report

Turn 4. The field report records the customer's two interruptions and remains relevant while the cause is unresolved.

3. working hypothesis

Turn 6. A working hypothesis remains under investigation without being presented as a supported causal finding.

4. correction notice

Turn 8. A correction notice explicitly amends the earlier claim so recipients do not continue relying on its unsupported certainty.

5. traceable record

Turn 10. A traceable record connects evidence to its source, event time, unit, and configuration rather than leaving context ambiguous.

6. resolution commitment

Turn 12. A resolution commitment promises an outcome or timing that remains unsupported while the cause and repair are unresolved.

7. interim update

Turn 14. An interim update reports progress before final resolution and should distinguish findings, uncertainties, and next steps.

8. service instruction

Turn 16. A service instruction must come through the authorized product-specific process; the correction does not authorize operating or repair changes.

9. case owner

Turn 18. The case owner coordinates the investigation communication and follow-up so the customer has a clear responsible contact.

10. Closure confirmation

Turn 20. Closure confirmation requires the actual case conditions to be satisfied; correcting an email alone does not resolve the underlying issue.

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07 / Answers and explanations / continued

F / Accuracy and scope

F1. Which request could help distinguish causes without presuming humidity is responsible?

B. Provide event times, installed configuration, and available environmental records linked to L18.

Traceable observations let investigators test competing explanations. Filtering or labeling the evidence to fit the prior claim would prejudice the investigation.

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F2. What should the correction not imply?

B. Permission to change operation or perform an unapproved repair

The briefing gives no authorized operating or repair change, so the message must not create one.

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F / Guided speaking

1. correction

Supplier: Our earlier claim needs a correction.

Turn 1. The earlier message presented an unconfirmed explanation as an established cause.

2. hypothesis

Customer: Contamination remains a hypothesis.

Turn 2. The briefing explicitly says contamination has not been confirmed as the cause.

3. update

Supplier: Friday noon is the next update.

Turn 3. The promised milestone is a progress report rather than a completed repair.

4. open

Customer: The investigation remains open.

Turn 4. Neither the cause nor the resolution has been established in the supplied facts.

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07 / Answers and explanations / continued

F / Rebuild the exchange

1. Rebuild the exchange from "Correct the cause without losing the customer". Nia: "What will that update contain if the cause is still open? Saying we are working on it would give us little new information." Marco: [missing response] Nia: "One colleague asked whether the correction means we should change how the unit is used or attempt a repair. We have not received an authorized instruction." Which response belongs in the gap?

B. The interim update will separate confirmed findings, open hypotheses, outstanding evidence, and the next review point. It will not turn the communication deadline into a promised repair date.

A Not here. This line belongs to turn 4, after Nia says: "Please keep the two interruptions in the record. Uncertainty about the explanation does not change what our operators reported or the disruption they experienced." It addresses that point, not the missing turn in the supplied exchange.

B Correct. This is Marco's response in turn 14. It connects Nia's preceding point with Nia's follow-up. An interim update reports progress before final resolution and should distinguish findings, uncertainties, and next steps.

C Not here. This line belongs to turn 6, after Nia says: "Should our internal summary remove humidity entirely? I want it to be accurate without hiding an explanation that your engineers are still examining." It addresses that point, not the missing turn in the supplied exchange.

D Not here. This line belongs to turn 2, after Nia says: "Your email said humidity caused the two interruptions on L18. Our team now understands that the cause has not been confirmed, so we need the record corrected." It addresses that point, not the missing turn in the supplied exchange.

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08 / Answers and explanations

A / Read the situation

A1. What does 100 counts mean for H2?

D. 1 mm

H2 sends hundredths of a millimeter, so one hundred counts represent one millimeter.

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A2. What does S1 currently display for those 100 counts?

A. 100 mm

S1 still applies revision 1's interpretation of one millimeter for each transmitted count.

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A3. Which configuration has the earlier test evidence?

D. H1 with S1 under revision 1

The briefing identifies the earlier tests as H1, S1, and the approved revision-1 interface.

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D / Response choices

D1. Which diagnosis matches the facts?

B. H2 and S1 use different scaling for the same transmitted count.

H2 encodes hundredths of a millimeter while S1 interprets whole millimeters.

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D2. For H2's 100-count message, which correction addresses the unit meaning?

C. Multiply 100 by 0.01 mm per count to obtain 1 mm; changing only the display label is insufficient.

Each count represents one hundredth of a millimeter. Multiplication by the encoded unit scale gives the intended physical value; a label change does not correct the number.

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08 / Answers and explanations / continued

D3. A colleague needs the term for this meaning: An identified version or assembly of hardware. Which term fits?

D. hardware build

A Not here. interface owner: The role responsible for maintaining the interface definition. The usual combination is "identify the interface owner".

B Not here. version negotiation: A process for identifying or agreeing compatible interface versions. The usual combination is "define version negotiation".

C Not here. payload: The data carried inside a message or transmission. The usual combination is "inspect the payload".

D Correct. hardware build: An identified version or assembly of hardware. The usual combination is "identify the hardware build".

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D4. Rebuild the exchange from "The same number, a different unit". Noah: "Our earlier test passed. Before anybody uses that result to clear H2, which actual builds and interface revision did the test cover?" Isabel: [missing response] Noah: "I found the revision-two proposal in the folder. Its presence does not mean the new scale is approved, even though the hardware test build already uses it." Which response belongs in the gap?

D. The configuration record says H1, S1, revision one. Preserve that result as evidence for that combination; it was not a test of H2.

A Not here. This line belongs to turn 2, after Noah says: "The message arrives without an error, but S1 displays one hundred millimeters. You expected one millimeter. Can we compare the transmitted count and its meaning?" It addresses that point, not the missing turn in the supplied exchange.

B Not here. This line belongs to turn 8, after Noah says: "I found the revision-two proposal in the folder. Its presence does not mean the new scale is approved, even though the hardware test build already uses it." It addresses that point, not the missing turn in the supplied exchange.

C Not here. This line belongs to turn 14, after Noah says: "Should I discard every earlier test, or can some results remain useful? I want to avoid both unsupported reuse and rerunning unrelated checks without a reason." It addresses that point, not the missing turn in the supplied exchange.

D Correct. This is Isabel's response in turn 6. It connects Noah's preceding point with Noah's follow-up. The configuration record identifies the exact H1, S1, and revision-one combination behind the earlier evidence.

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E / Conversation

1. unit scaling

Turn 2. Unit scaling converts the encoded count into a physical quantity; H2 now uses hundredths of a millimeter.

08 / Answers and explanations / continued

2. configuration mismatch

Turn 4. The configuration mismatch pairs hardware using the new scale with software expecting the old scale.

3. configuration record

Turn 6. The configuration record identifies the exact H1, S1, and revision-one combination behind the earlier evidence.

4. interface control document

Turn 8. The interface control document is the controlled shared definition; a draft revision does not replace the approved one automatically.

5. conversion factor

Turn 10. The conversion factor is 0.01 millimeters per count, converting H2's value of 100 into 1 millimeter.

6. change impact analysis

Turn 12. Change impact analysis identifies which functions, records, requirements, and tests are affected by the scaling change.

7. test evidence reuse

Turn 14. Test evidence reuse requires justified continued applicability; previous success cannot simply be transferred to the changed pairing.

8. regression tests

Turn 16. Regression tests check that the change has not broken previously working behavior in the defined affected scope.

9. interface owner

Turn 18. The interface owner maintains the shared definition and coordinates controlled changes across the participating teams.

10. integration readiness

Turn 20. Integration readiness requires the agreed configuration and supporting evidence, not merely understanding the source of a mismatch.

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08 / Answers and explanations / continued

F / Accuracy and scope

F1. How should earlier evidence be treated?

A. Preserve it and assess which results remain applicable to the changed configuration.

Prior results remain valid records of the old configuration; reuse for the change needs justification.

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F2. What is needed before claiming integration readiness?

D. A resolved interface definition, controlled configuration, and appropriate reviewed test evidence

Readiness depends on a shared approved basis and evidence, not merely connectivity or preference.

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F / Guided speaking

1. 5

Engineer: The proposed distance is 5 mm.

Turn 1. Fifty counts multiplied by 0.1 millimeters per count equals five millimeters.

2. 50

Reviewer: The old software displays 50 mm.

Turn 2. The old interpretation uses one millimeter per count, producing fifty millimeters.

3. scaling

Engineer: The difference comes from unit scaling.

Turn 3. The same count is converted using two different physical-unit multipliers.

4. approval

Reviewer: The proposed change still needs approval.

Turn 4. The briefing explicitly states that the new interface proposal is unapproved.

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08 / Answers and explanations / continued

F / Rebuild the exchange

1. Rebuild the exchange from "The same number, a different unit". Noah: "Should I discard every earlier test, or can some results remain useful? I want to avoid both unsupported reuse and rerunning unrelated checks without a reason." Isabel: [missing response] Noah: "I will list affected requirements and expected values for the proposed pairing. The tests should catch both a wrong factor and a correct-looking number from the wrong configuration." Which response belongs in the gap?

D. Assess test evidence reuse against the change. Keep applicable results with their original configuration references, and identify where changed behavior needs new evidence.

A Not here. This line belongs to turn 8, after Noah says: "I found the revision-two proposal in the folder. Its presence does not mean the new scale is approved, even though the hardware test build already uses it." It addresses that point, not the missing turn in the supplied exchange.

B Not here. This line belongs to turn 2, after Noah says: "The message arrives without an error, but S1 displays one hundred millimeters. You expected one millimeter. Can we compare the transmitted count and its meaning?" It addresses that point, not the missing turn in the supplied exchange.

C Not here. This line belongs to turn 6, after Noah says: "Our earlier test passed. Before anybody uses that result to clear H2, which actual builds and interface revision did the test cover?" It addresses that point, not the missing turn in the supplied exchange.

D Correct. This is Isabel's response in turn 14. It connects Noah's preceding point with Noah's follow-up. Test evidence reuse requires justified continued applicability; previous success cannot simply be transferred to the changed pairing.

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Review 1 / Explanations

Cumulative review

1. A colleague needs the term for this meaning: A limit on available design choices. Which term fits?

B. design constraint

A Not here. requirement allocation: Assignment of a requirement to a system element. The usual combination is "review requirement allocation".

B Correct. design constraint: A limit on available design choices. The usual combination is "work within a design constraint".

C Not here. traceability: Recorded connections between needs, requirements, and evidence. The usual combination is "maintain traceability".

D Not here. service life: The intended period of use under specified conditions. The usual combination is "state the service life".

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2. A colleague needs the term for this meaning: An assessment using the most adverse allowed combination. Which term fits?

D. worst-case analysis

A Not here. release recommendation: Advice that a design proceed to a release decision. The usual combination is "qualify a release recommendation".

B Not here. assumption log: A record of premises used in an analysis. The usual combination is "review the assumption log".

C Not here. design review: A structured examination of a design and its supporting evidence. The usual combination is "conduct a design review".

D Correct. worst-case analysis: An assessment using the most adverse allowed combination. The usual combination is "document a worst-case analysis".

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Review 1 / Explanations / continued

3. Rebuild the exchange from "Lightweight compared with what?". Julia: "I will ask about temperature, humidity, and handling. Some units may move between workstations, so we should not assume they all stay fixed in one installation." Wei: [missing response] Julia: "Once the conditions are clear, I assume we will need a way to show that the proposal has been met, not just a convincing description." Which response belongs in the gap?

D. Record each unresolved premise in the assumption register. Give it an owner and a confirmation point rather than hiding it inside a confident statement about durability.

A Not here. This line belongs to turn 14, after Julia says: "I also want the specification to preserve why we chose the limit. A later reviewer may otherwise change it without understanding the installation problem behind it." It addresses that point, not the missing turn in the supplied exchange.

B Not here. This line belongs to turn 4, after Julia says: "Use that value for discussion. I mean the empty enclosure with its cover and fasteners, not the electronics that our team will install later." It addresses that point, not the missing turn in the supplied exchange.

C Not here. This line belongs to turn 8, after Julia says: "Could we leave the conditions to the design team? I do not want to slow the project by asking the customer for every detail immediately." It addresses that point, not the missing turn in the supplied exchange.

D Correct. This is Wei's response in turn 10. It connects Julia's preceding point with Julia's follow-up. An assumption register preserves unconfirmed premises and their ownership until they are resolved.

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4. Rebuild the exchange from "The drawing fits; the evidence is missing". Ahmed: "I will revise the minutes to keep the interface item open. The release recommendation will remain unresolved until the evidence and required review are available." Clara: [missing response] Ahmed: "Once the reviewed analysis is available, we can record the result and route the recommendation to the authorized decision maker with any remaining conditions." Which response belongs in the gap?

A. Keep that open item visible in the action list. A meeting ending or an owner accepting the task must not make its status appear complete.

A Correct. This is Clara's response in turn 18. It connects Ahmed's preceding point with Ahmed's follow-up. An open item records the unresolved matter until the stated closure conditions are satisfied.

B Not here. This line belongs to turn 4, after Ahmed says: "The nominal geometry is comfortably above one millimeter. I agree that it does not show every combination, but I do not want the team to hear that the design has failed." It addresses that point, not the missing turn in the supplied exchange.

C Not here. This line belongs to turn 10, after Ahmed says: "I can own the analysis. I will identify the confirmed supplier revision, state the tolerance assumptions, and present the resulting minimum against R-14." It addresses that point, not the missing turn in the supplied exchange.

D Not here. This line belongs to turn 14, after Ahmed says: "I will ask the chair to separate any permitted preparatory work from release. We should not imply that every downstream activity has the same dependency." It addresses that point, not the missing turn in the supplied exchange.

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Review 2 / Explanations

Cumulative review

1. A colleague needs the term for this meaning: The physical or other process producing a failure. Which term fits?

B. failure mechanism

A Not here. reproducibility: Measurement precision under specified changed conditions, such as different laboratories or operators. The usual combination is "assess reproducibility".

B Correct. failure mechanism: The physical or other process producing a failure. The usual combination is "investigate the failure mechanism".

C Not here. FMEA: Failure mode and effects analysis, a structured review of possible failures and consequences. The usual combination is "update the FMEA".

D Not here. diagnostic evidence: Information used to distinguish possible explanations. The usual combination is "preserve diagnostic evidence".

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2. A colleague needs the term for this meaning: A quantified expression of doubt about a measured value. Which term fits?

D. measurement uncertainty

A Not here. population: The full set of items about which an inference is intended. The usual combination is "define the target population".

B Not here. test protocol: The documented plan and procedure for a test. The usual combination is "approve the test protocol".

C Not here. verification: Checking that specified requirements have been met. The usual combination is "complete requirement verification".

D Correct. measurement uncertainty: A quantified expression of doubt about a measured value. The usual combination is "evaluate measurement uncertainty".

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Review 2 / Explanations / continued

3. Rebuild the exchange from "The drawing fits; the evidence is missing". Ahmed: "I can own the analysis. I will identify the confirmed supplier revision, state the tolerance assumptions, and present the resulting minimum against R-14." Clara: [missing response] Ahmed: "Could the chair record conditional approval and allow the release team to continue? I want to avoid delaying work that does not depend on this interface." Which response belongs in the gap?

B. That provides the intended closure evidence. The reviewer still needs to assess the result; attaching a file is not itself the same as resolving the concern.

A Not here. This line belongs to turn 14, after Ahmed says: "I will ask the chair to separate any permitted preparatory work from release. We should not imply that every downstream activity has the same dependency." It addresses that point, not the missing turn in the supplied exchange.

B Correct. This is Clara's response in turn 10. It connects Ahmed's preceding point with Ahmed's follow-up. Closure evidence must show that the specific requirement gap has been resolved on the confirmed configuration.

C Not here. This line belongs to turn 8, after Ahmed says: "Please replace check fit with the actual task: confirm the supplier revision and assess minimum clearance against R-14. I can own that analysis." It addresses that point, not the missing turn in the supplied exchange.

D Not here. This line belongs to turn 18, after Ahmed says: "I will revise the minutes to keep the interface item open. The release recommendation will remain unresolved until the evidence and required review are available." It addresses that point, not the missing turn in the supplied exchange.

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Review 2 / Explanations / continued

4. Rebuild the exchange from "Three passes do not mean every condition". Amina: "I will also avoid adding a confidence percentage. The supplied records do not include a statistical sampling plan, uncertainty budget, or lifetime analysis." Ben: [missing response] Amina: "The revised headline will say three revision-B prototypes met the response-time criterion during a two-hour bench test at twenty degrees. The next sentence will identify the untested temperatures." Which response belongs in the gap?

B. Correct. A reliability claim needs its own defined basis. The fact that no failure occurred in these runs does not establish a zero population failure probability.

A Not here. This line belongs to turn 4, after Amina says: "Let us put the actual conditions beside the result. These were revision-B prototypes, tested for two hours at twenty degrees Celsius under the bench procedure." It addresses that point, not the missing turn in the supplied exchange.

B Correct. This is Ben's response in turn 18. It connects Amina's preceding point with Amina's follow-up. A reliability claim requires a defined performance, time, conditions, and supporting basis beyond a small unqualified pass count.

C Not here. This line belongs to turn 14, after Amina says: "The slide also calls the product fully validated. We have not supplied evidence for the complete use context, so that phrase creates a second overclaim." It addresses that point, not the missing turn in the supplied exchange.

D Not here. This line belongs to turn 8, after Amina says: "I will write three out of three met the criterion. That is clearer than a large one-hundred-percent headline with the sample size hidden below it." It addresses that point, not the missing turn in the supplied exchange.

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Review 3 / Explanations

Cumulative review

1. A colleague needs the term for this meaning: Design choices suited to the intended manufacturing process, abbreviated DFM. Which term fits?

C. design for manufacture

A Not here. scrap allowance: A stated cost or quantity provision for unusable production. The usual combination is "include a scrap allowance".

B Not here. break-even volume: The quantity at which compared total costs are equal. The usual combination is "calculate break-even volume".

C Correct. design for manufacture: Design choices suited to the intended manufacturing process, abbreviated DFM. The usual combination is "review design for manufacture".

D Not here. nonrecurring cost: A cost incurred once for the defined program or setup. The usual combination is "identify nonrecurring cost".

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2. A colleague needs the term for this meaning: Capacity associated with a defined ultimate failure limit. Which term fits?

A. ultimate capacity

A Correct. ultimate capacity: Capacity associated with a defined ultimate failure limit. The usual combination is "state ultimate capacity".

B Not here. model validity: The degree to which a model is suitable for its intended assessment. The usual combination is "assess model validity".

C Not here. factor of safety: A defined ratio comparing capacity and demand on a stated basis. The usual combination is "state the factor of safety".

D Not here. standard edition: The identified version of a published standard. The usual combination is "confirm the standard edition".

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Review 3 / Explanations / continued

3. Rebuild the exchange from "Three passes do not mean every condition". Amina: "The intended operating range is ten to forty degrees. Since we tested only twenty, the other temperatures remain a gap rather than a demonstrated pass." Ben: [missing response] Amina: "Would it help to distinguish checking this performance criterion from confirming that the product works adequately for its intended users and operating tasks?" Which response belongs in the gap?

A. That is a test coverage limitation. State it directly; do not imply the untested temperatures failed, but do not label them verified either.

A Correct. This is Ben's response in turn 10. It connects Amina's preceding point with Amina's follow-up. Test coverage describes which requirements and conditions were actually addressed, exposing the untested temperature range.

B Not here. This line belongs to turn 16, after Amina says: "What should I say if someone asks about ten and forty degrees? We have no supporting model or test at those temperatures in this package." It addresses that point, not the missing turn in the supplied exchange.

C Not here. This line belongs to turn 8, after Amina says: "I will write three out of three met the criterion. That is clearer than a large one-hundred-percent headline with the sample size hidden below it." It addresses that point, not the missing turn in the supplied exchange.

D Not here. This line belongs to turn 6, after Amina says: "The recorded maximum response times were one hundred fifty, one hundred sixty, and one hundred seventy-five milliseconds. The criterion allowed up to two hundred milliseconds." It addresses that point, not the missing turn in the supplied exchange.

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Review 3 / Explanations / continued

4. Rebuild the exchange from "A ratio is not a compliance decision". Rosa: "Then the revised note can preserve the factor of two, identify the model exclusions, and say that the compliance conclusion remains unestablished pending the required review." Malik: [missing response] Rosa: "I will keep the current restrictions visible and identify who will confirm the requirements and review the evidence. I will not call the design either safe or unsafe from this ratio alone." Which response belongs in the gap?

D. Also distinguish that from authorized sign-off. No release approval is recorded, and a technical result must not silently become permission to proceed.

A Not here. This line belongs to turn 16, after Rosa says: "We also have no formal conformity assessment recorded. I should not write as though assembling the internal note has completed whatever external or internal route applies." It addresses that point, not the missing turn in the supplied exchange.

B Not here. This line belongs to turn 12, after Rosa says: "I will check the contract requirements too. Can we identify the applicable documents and versions before the note lists standards that may not govern this product?" It addresses that point, not the missing turn in the supplied exchange.

C Not here. This line belongs to turn 6, after Rosa says: "I will name the failure condition beside the ratio. Which inputs and assumptions must the reviewer see to understand what this particular calculation covers?" It addresses that point, not the missing turn in the supplied exchange.

D Correct. This is Malik's response in turn 18. It connects Rosa's preceding point with Rosa's follow-up. Authorized sign-off is an actual approval by the relevant authority, which is not supplied by the preliminary calculation.

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Review 4 / Explanations

Cumulative review

1. A colleague needs the term for this meaning: Behavior described by a user but not necessarily independently verified. Which term fits?

A. reported symptom

A Correct. reported symptom: Behavior described by a user but not necessarily independently verified. The usual combination is "record the reported symptom".

B Not here. resolution commitment: A promise about when or how an issue will be resolved. The usual combination is "avoid an unsupported resolution commitment".

C Not here. return authorization: Permission and arrangements for returning an item. The usual combination is "confirm return authorization".

D Not here. case reference: An identifier connecting records for the same issue. The usual combination is "use the case reference".

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2. A colleague needs the term for this meaning: The conversion between encoded values and physical units. Which term fits?

B. unit scaling

A Not here. test evidence reuse: Using earlier results where their continued applicability is justified. The usual combination is "justify test evidence reuse".

B Correct. unit scaling: The conversion between encoded values and physical units. The usual combination is "document unit scaling".

C Not here. interface control document: A controlled definition of an interface, abbreviated ICD. The usual combination is "update the interface control document".

D Not here. message schema: The defined structure and meaning of a message. The usual combination is "version the message schema".

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Review 4 / Explanations / continued

3. Rebuild the exchange from "A ratio is not a compliance decision". Rosa: "Could I say the static result is encouraging, provided I avoid saying it proves the product safe? I do not want to hide useful work either." Malik: [missing response] Rosa: "I will check the contract requirements too. Can we identify the applicable documents and versions before the note lists standards that may not govern this product?" Which response belongs in the gap?

A. Report the result, but keep model validity and review status explicit. The model must be suitable for the claim, and the acceptance basis still needs to be identified.

A Correct. This is Malik's response in turn 10. It connects Rosa's preceding point with Rosa's follow-up. Model validity concerns whether the model is appropriate for the claimed assessment, beyond simply producing a numerical output.

B Not here. This line belongs to turn 8, after Rosa says: "Fatigue and dynamic loading were excluded. I will state that directly instead of allowing the static result to stand in for those separate questions." It addresses that point, not the missing turn in the supplied exchange.

C Not here. This line belongs to turn 2, after Rosa says: "The note says compliant, and the preliminary analysis reports a factor of two. Before I circulate it, I want to check whether that label is justified." It addresses that point, not the missing turn in the supplied exchange.

D Not here. This line belongs to turn 20, after Rosa says: "I will keep the current restrictions visible and identify who will confirm the requirements and review the evidence. I will not call the design either safe or unsafe from this ratio alone." It addresses that point, not the missing turn in the supplied exchange.

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Review 4 / Explanations / continued

4. Rebuild the exchange from "The same number, a different unit". Noah: "Who will maintain the shared definition? Separate hardware and software notes could leave us with this disagreement again at the next test." Isabel: [missing response] Noah: "I will. Today's outcome is an understood scaling mismatch and assigned evidence preparation, not an approved new interface or production release." Which response belongs in the gap?

D. We need a named interface owner and a confirmed approval route. I will bring the hardware-build details; please attach the software interpretation and affected-test list.

A Not here. This line belongs to turn 2, after Noah says: "The message arrives without an error, but S1 displays one hundred millimeters. You expected one millimeter. Can we compare the transmitted count and its meaning?" It addresses that point, not the missing turn in the supplied exchange.

B Not here. This line belongs to turn 8, after Noah says: "I found the revision-two proposal in the folder. Its presence does not mean the new scale is approved, even though the hardware test build already uses it." It addresses that point, not the missing turn in the supplied exchange.

C Not here. This line belongs to turn 20, after Noah says: "I will. Today's outcome is an understood scaling mismatch and assigned evidence preparation, not an approved new interface or production release." It addresses that point, not the missing turn in the supplied exchange.

D Correct. This is Isabel's response in turn 18. It connects Noah's preceding point with Noah's follow-up. The interface owner maintains the shared definition and coordinates controlled changes across the participating teams.

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Additional case 1 / Explanations

Extended conversation

1. quantity of interest

Turn 2. The quantity of interest is the specific output used for the intended assessment; different outputs may behave differently under refinement.

2. Mesh convergence

Turn 4. Mesh convergence concerns the behavior of a specified result as the discretization is refined; stability of one output does not establish it for every output.

3. stress singularity

Turn 6. A stress singularity can occur at an idealized geometric or loading feature, producing a local stress that does not converge to a finite value with refinement.

4. boundary conditions

Turn 10. Boundary conditions define how the modeled system is constrained or interacts with its surroundings; they must represent the intended assessment adequately.

5. Verification

Turn 14. Verification addresses whether the model implementation and numerical solution are correct for the specified model; it is distinct from assessing representation of reality.

6. sensitivity analysis

Turn 16. Sensitivity analysis examines how outputs change when selected inputs or assumptions vary; it helps identify which uncertainties matter to the conclusion.

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Transfer exchange

1. peak

Lead: Stability of the average does not establish the local peak.

Turn 1. Different outputs may converge at different rates, so one stable measure cannot settle the other.

Additional case 1 / Explanations / continued

2. assessment

Analyst: State the specific quantity of interest for the assessment.

Turn 2. The intended assessment determines which output requires adequate supporting evidence.

3. report

Lead: Keep the remaining numerical limitation visible in the report.

Turn 3. The report must disclose the unresolved behavior instead of hiding it behind an average.

4. criterion

Analyst: A smooth image is not an acceptance criterion.

Turn 4. Visual appearance does not replace the defined technical basis for accepting the result.

[Return to the conversation, page 103](#)

Additional case 2 / Explanations

Extended conversation

1. form-and-fit

Turn 2. Form-and-fit concerns physical characteristics and compatibility at the mounting or connection interface; it does not establish equivalent function or performance.

2. interface requirements

Turn 4. Interface requirements define the relevant mechanical, electrical, and information connections; a similar connector appearance does not demonstrate compliance.

3. transfer function

Turn 6. The transfer function here describes the relationship between the measured input and the sensor output; a changed scale can affect downstream interpretation.

4. bill of materials

Turn 12. The bill of materials identifies the parts belonging to the defined product configuration; listing a candidate as approved would misstate its status.

5. approved alternate

Turn 14. An approved alternate has completed the applicable assessment and approval for its defined use; a supplier recommendation or evaluation sample does not establish that status.

6. effectivity

Turn 16. Effectivity defines where or when an approved change applies, such as specified builds or serial ranges, avoiding an uncontrolled mix of configurations.

[Return to the conversation, page 105](#)

Transfer exchange

1. use

Engineer: These parts were ordered for evaluation, not production use.

Turn 1. The order's stated purpose is assessment and does not authorize installation in production products.

Additional case 2 / Explanations / continued

2. history

Buyer: Correct the status without losing the purchase history.

Turn 2. The record should accurately show the correction while preserving what was ordered and why.

3. requirements

Engineer: Complete the comparison against the applicable requirements.

Turn 3. Equivalence must be assessed against the relevant product requirements, not assumed from availability.

4. alternates

Buyer: Keep the candidate separate from approved alternates.

Turn 4. An unassessed candidate must not appear to have the same status as an authorized substitute.

[Return to the conversation, page 108](#)

Additional case 3 / Explanations

Extended conversation

1. factors

Turn 2. Factors are the input variables being studied; both fan setting and vent design changed between these runs, so their separate effects are not established.

2. design matrix

Turn 4. The design matrix identifies the planned combinations of factor settings; it exposes missing combinations needed for the intended comparison.

3. interaction

Turn 6. An interaction means the effect of one factor depends on the level of another; separate single-change conclusions may miss that relationship.

4. response variable

Turn 8. The response variable is the measured outcome of the experiment, with its location, timing, and calculation defined so results are comparable.

5. replicates

Turn 10. Replicates repeat the experimental treatment on appropriate independent experimental units or runs; multiple readings within one run do not automatically provide them.

6. randomization

Turn 14. Randomization varies the allocation or order to reduce systematic association with uncontrolled effects; practical restrictions must be handled explicitly in the design.

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Transfer exchange

1. trials

Lead: Ten readings from one run are not automatically ten independent trials.

Turn 1. Measurements within a single run do not automatically represent independent repetitions of the experiment.

Additional case 3 / Explanations / continued

2. variation

Engineer: Identify the experimental unit and the source of variation.

Turn 2. The design must establish what is independently repeated and which variation the evidence captures.

3. count

Lead: Keep the measurement count distinct from the run count.

Turn 3. The number of readings and the number of test runs answer different questions.

4. supports

Engineer: Limit the conclusion to what the design actually supports.

Turn 4. A conclusion must reflect the experimental design rather than an inflated apparent sample size.

[Return to the conversation, page 112](#)

Find a phrase by purpose

Requirements and Constraints

Clarify the adjective: What maximum mass would count as lightweight?

Set the boundary: Does that value include the cover and fasteners?

Exclude explicitly: Electronics are outside this mass boundary.

[Full phrase bank, page 7](#)

Design Reviews and Technical Pushback

Locate the concern: My concern is the evidence for R-14.

Acknowledge the work: The nominal geometry is clear in the model.

Distinguish the claim: Nominal clearance is not minimum clearance across tolerances.

[Full phrase bank, page 17](#)

Failure Modes and Reliability

State the observation: S7 stopped producing an output at minute 46.

Preserve the duration: The planned run was 60 minutes.

Separate cause from symptom: Loss of output is the observed mode, not the confirmed cause.

[Full phrase bank, page 29](#)

Testing, Validation, and Data Interpretation

Lead with the result: All three prototypes met the stated criterion.

Name the configuration: These results apply to revision B.

Give the conditions: The test ran for two hours at 20 degrees Celsius.

[Full phrase bank, page 42](#)

Find a phrase by purpose / continued

Manufacturability and Cost Engineering

Set the comparison: Use the same 3,000-unit quantity for both options.

Name the categories: Include material, assembly, and one-time tooling.

Challenge the narrow claim: Lower material cost does not necessarily mean lower total cost.

[Full phrase bank, page 55](#)

Safety Factors and Compliance

Ask for the basis: Compliant with which applicable requirement?

Identify the version: Which standard edition does the assessment use?

Name the convention: The reported factor uses the stated capacity-to-demand ratio.

[Full phrase bank, page 66](#)

Field Issues and Customer Communication

Acknowledge the correction: Our earlier email overstated the cause.

Withdraw the unsupported claim: Humidity has not been confirmed as the cause.

Preserve the hypothesis: It remains one explanation under investigation.

[Full phrase bank, page 78](#)

Systems Integration and Interface Control

Identify the pairing: Which hardware build and software version are under test?

Name the contract: The approved interface is still revision 1.

State the change: H2 sends hundredths of a millimeter.

[Full phrase bank, page 89](#)

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References and publication notes

All cases, organizations, figures, and conversations are fictional teaching material, not transcripts. Communication practice does not replace qualified advice or current workplace procedures.

[1] NASA. Systems Engineering Handbook, Appendix C: How to Write a Good Requirement.

Background on clear, verifiable requirements. The enclosure requirements and customer discussion are original fictional examples. Source checked 10 October 2026.

<https://www.nasa.gov/reference/appendix-c-how-to-write-a-good-requirement/>

[2] NASA. Systems Engineering Handbook, Section 6: Crosscutting Technical Management.

Background on interface and configuration management. The book does not prescribe NASA procedures for other organizations. Source checked 10 October 2026.

<https://www.nasa.gov/reference/6-0-crosscutting-technical-management/>

[3] ASQ. What Is Failure Mode and Effects Analysis?

Background on distinguishing failure modes, effects, and possible causes. No scoring scale or acceptance rule is asserted as universal. Source checked 10 October 2026.

<https://asq.org/quality-resources/fmea>

[4] NIST/SEMATECH. Engineering Statistics Handbook, Section 8.1.3.2: Lack of Failures.

Background on the limits of reliability information when few failures are observed. The prototype case is language practice, not a statistical qualification plan. Source checked 10 October 2026.

<https://www.itl.nist.gov/div898/handbook/apr/section1/apr132.htm>

Companion course

The website offers the eight-lesson course and related practice. This book can be used independently. No audio access or external account is needed for its exercises.

<https://englishladder.com/efsp-engineering.html>

Challenge the assumption. Explain the evidence.

Eight technical conversations that connect requirements, engineering evidence, trade-offs, and decisions.

Requirements and Constraints

Mass is not the same as the mass of the fully populated product. The proposal includes the enclosure, cover, and fasteners but excludes electronics. A five-year target needs defined use conditions and a suitable evidence plan before it can support a durability claim.

Design Reviews and Technical Pushback

A nominal 2 mm gap does not establish the minimum gap across permitted variation. Missing evidence also does not prove physical interference. The supported finding is that R-14 is not yet verified on a confirmed configuration.

Failure Modes and Reliability

The observed mode is loss of output, not connector damage. A connector problem might explain the event, but it remains a hypothesis. Checking the setup is necessary to interpret the result; it does not justify deleting an inconvenient observation.

Testing, Validation, and Data Interpretation

Three out of three is a 100% observed pass fraction for this test. It is not proof of perfect reliability in the population or across the operating range. The largest recorded maximum, 175 ms, is 25 ms below the stated 200 ms criterion.

Phil Stilwell

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