

Design in practice · supported focus

International Baccalaureate · IB Diploma · Design Technology · HL

Scope and prerequisites

Supported HL focus. First assessment 2027 target; current brief and public guide return 403; 2016 SL/HL briefs are historical. Remaining guide, assessment and practical requirements retain their recorded holds.

Prerequisites: read the stated quantities and units, use arithmetic and the model conditions below. Each lesson develops its own method before independent transfer.

These are original or explicitly fictional teaching examples, not actual measurements or completed assessed learner investigations.

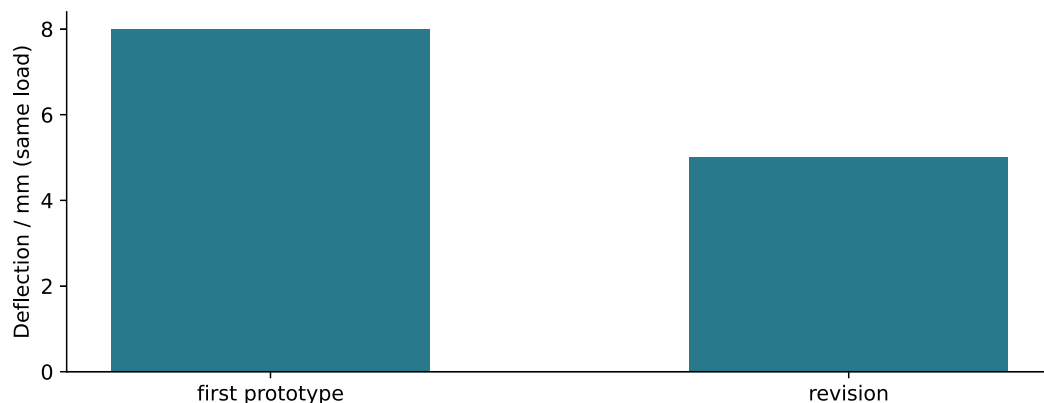
Models, materials and iterative prototyping

■ What would explain this observation?

- A cardboard **prototype** can reveal reach and arrangement without proving that the final material is strong enough. Different models answer different questions.
- Start with a prediction. State the quantities or features you would compare, then decide what evidence could distinguish two explanations.

■ Build the model

- A model represents selected features of a design. A prototype supports testing before or during development. Material selection depends on mechanical properties, manufacture, use conditions and end-of-life choices.
- prototype: A developing version used to test a solution; **iteration** : Revision guided by evidence and repeated testing.



■ Choose evidence that can test it

- State what each model includes and omits. Compare tests with the same load, geometry and conditions. Iteration means using evidence to revise a solution and testing the revision against the original success criteria.
- Make a low-risk model under school workshop rules. Record dimensions, material, process and test method. Use photographs, measurements and user feedback as evidence. Machines and load tests require teacher supervision and approved guards.

■ Work from known quantities

- State the known values and their units. Choose the relation because its assumptions fit this case, then rearrange before substitution.
- Known: a beam prototype deflects 8 mm under a stated load; a revision deflects 5 mm under the same conditions. Reduction = $(8-5)/8 \times 100 = 37.5\%$. The result supports greater stiffness in that test, not proof of every strength or fatigue property.

Example:

Deflection falls from 10 mm to 6 mm under equal conditions. Find percentage reduction. Use the same sequence: known quantities → model → relation → substitution → unit and interpretation.

■ Check the conclusion and its limits

- Stiffness is resistance to elastic deformation; strength concerns failure stress. A visually accurate model need not reproduce material behaviour.
- Return to the original observation. Explain what the result supports, which conditions it assumes, and one way to test a competing explanation.

Warn:

An attractive model proves the final product mechanical safety. This claim is false: Stiffness is resistance to elastic deformation; strength concerns failure stress. A visually accurate model need not reproduce material behaviour.

Key:

Models, materials and iterative prototyping: State what each model includes and omits. Compare tests with the same load, geometry and conditions. Iteration means using evidence to revise a solution and testing the revision against the original success criteria.

Manufacture: tolerances, variation and inspection

■ What would explain this observation?

- Two parts can each match a nominal drawing yet fail to assemble if allowed variation has not been considered. Manufacture produces a range of dimensions.
 - Start with a prediction. State the quantities or features you would compare, then decide what evidence could distinguish two explanations.
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■ Build the model

- A **tolerance** specifies an allowed dimensional range around or beside a nominal value. Precision concerns consistency of repeated measurements or production, while accuracy concerns agreement with a reference. Process selection must consider material, geometry, quantity, surface finish, waste and achievable variation rather than appearance alone.
- tolerance: The allowed range of variation in a specified dimension; **clearance** : The dimensional space between mating parts under the stated model.



■ Choose evidence that can test it

- For a worst-case clearance model, subtract the largest shaft from the smallest hole for minimum clearance, and the smallest shaft from the largest hole for maximum clearance. The calculation assumes the stated dimensional limits and ideal geometry. Shape, alignment, temperature and measurement uncertainty can affect actual assembly.
- Use safe school-made models or a provided dimension dataset. Specify dimension units, nominal values and limits before testing. Measure with an appropriate calibrated instrument at agreed positions, record every result and classify against the specified range. Retain rejected pieces and explain whether the problem concerns the design limits, process variation or measurement method.

■ Work from known quantities

- State the known values and their units. Choose the relation because its assumptions fit this case, then rearrange before substitution.
- Known: a hole is 10.0 ± 0.2 mm, giving 9.8–10.2 mm; a shaft is 9.5 ± 0.1 mm, giving 9.4–9.6 mm. Minimum clearance is $9.8 - 9.6 = 0.2$ mm and maximum is $10.2 - 9.4 = 0.8$ mm. This model predicts positive clearance across the stated limits. It does not establish strength or fitness for a safety-critical application.

Example:

A hole ranges from 12.0 to 12.4 mm and a shaft from 11.5 to 11.8 mm. Calculate minimum clearance. Use the same sequence: known quantities → model → relation → substitution → unit and interpretation.

■ Check the conclusion and its limits

- A tighter tolerance can increase cost, inspection time and waste, and may not improve the user outcome. A measuring instrument with a fine display does not automatically have the accuracy required to accept a part near its limit.
- Return to the original observation. Explain what the result supports, which conditions it assumes, and one way to test a competing explanation.

Warn:

A finer instrument display guarantees sufficiently accurate dimensional inspection. This claim is false: A tighter tolerance can increase cost, inspection time and waste, and may not improve the user outcome. A measuring instrument with a fine display does not automatically have the accuracy required to accept a part near its limit.

Key:

Manufacture: tolerances, variation and inspection: For a worst-case clearance model, subtract the largest shaft from the smallest hole for minimum clearance, and the smallest shaft from the largest hole for maximum clearance. The calculation assumes the stated dimensional limits and ideal geometry. Shape, alignment, temperature and measurement uncertainty can affect actual assembly.