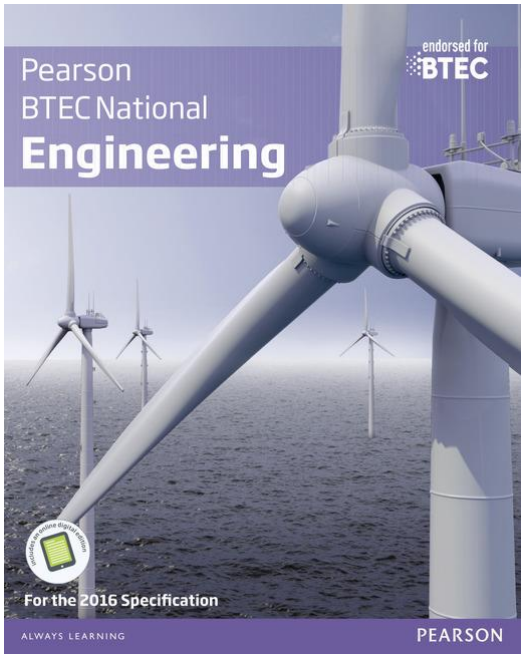
BTEC Level 3 Nationals in Engineering:
Unit 3

Your free sample of the student book: preparation for assessment

(BTEC National Engineering: Student Book 1 (with ActiveBook), ISBN: 9781292141008)



Getting ready for assessment

This section has been written to help you to do your best when you take the external assessment. Read through it carefully and ask your tutor if there is anything you are not sure about.

About the assessment

This unit is assessed by a supervised task. Pearson sets and marks the task.

You will be assessed on your ability to follow a standard development process of interpreting a brief, scoping initial design ideas, preparing a design proposal and evaluating your proposal.

Make sure that you arrive in good time for each session of the assessment, and check that you have everything you need beforehand. Make a schedule for completing the task, and leave yourself enough time at the end to check through your work.

Listen to and read carefully any instructions that you are given. Marks are often lost through not reading instructions properly and misunderstanding what you are being asked to do. Ensure that you have checked all aspects of the task before starting.

At the end of the supervised assessment period, proofread your work and correct any mistakes before handing it in.

As the guidelines for assessment can change, you should refer to the official assessment guidance on the Pearson Qualifications website for the latest definitive guidance.

Preparing for the assessment

Before the assessment you will be provided with a case study related to the assessment and will be given the opportunity to carry out independent preparatory research. You can then take notes into the supervised assessment - check with your tutor how long these can be. You must work independently and should not share your work with other learners. Your tutor cannot give you feedback during the preparation period.

Make sure you plan out the preparatory work to maximise your time examining the case study. For example, questions to think about might include:

- How is the product made, or could the proposed design be realised?
- What does the customer want from the product?
- What materials are used?
- Are there any particular constraints, such as those relating to cost, reliability, weight, functionality, servicing, environmental impact or sustainability?

The following table shows the key terms typically used in the assessment.

Command or term	Definition
Client brief	Outlines the client's expectations and requirements for the product.
Design	A drawing and/or specification to communicate the form, function and/or operational workings of a product prior to it being made or maintained.
Manufacture	To make a product for commercial gain.
Project log	A document to record the progress made, key activities and decisions taken during the development of a product.

Sample assessment

Preparatory case study

Case study

You are working for a company that makes flying model aircraft. The company wants to diversify its business and move into the building of more professional drone aircraft for use by farmers, cartographers and utility companies. Market research has suggested that a well-designed aircraft should be able to sell around 1000 units per annum with a production life of 3–5 years.

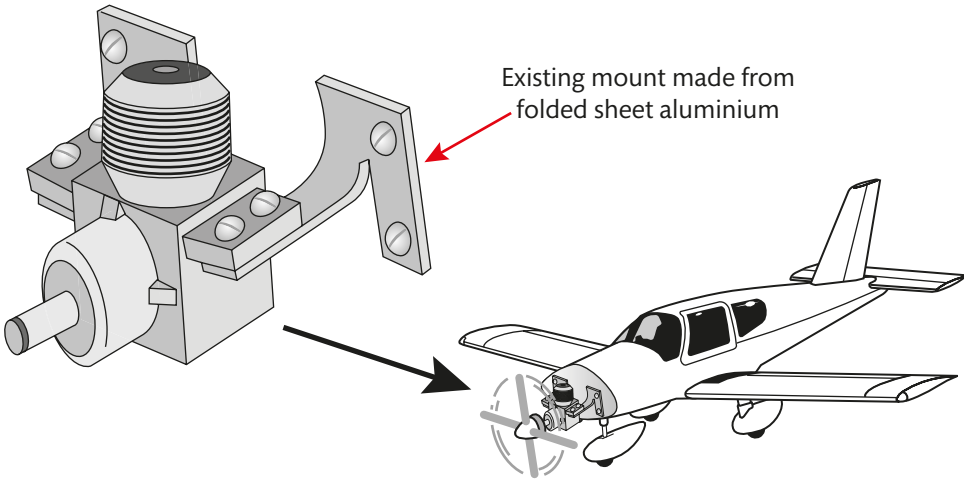


Figure 3.30 Designing a new engine mount for drone aircraft

Your particular responsibility is the engine mount (**Figure 3.30**), which on your existing aircraft is made from folded sheet aluminium. It is expected that in their current form these mounts will not be rigid enough for the new aircraft.

This is the type of case study you may be given before the assessment. You will be given a set period of time to investigate the case study and you are allowed to compile notes, which you can later use in the supervised assessment periods - check with your tutor how many notes you are allowed to take into the assessment.

Use the case study as an exercise to practise gathering information for the design task.

To help you get started, underline specific details in the description to help you draw out the key aspects of the case study. For example:

- You are told that the company is developing a professional drone aircraft rather than a hobbyist model. Write down what this might mean for the aircraft, its reliability and quality.
- You are given some information about possible users of the product. What does this mean in terms of how the product will be used? Will the customers want to do lots of servicing? What sort of environment might the product have to work in (e.g. wet weather, possible contamination from oil or fuel)? What does this mean for the design and the materials used? Do you need to spend some time researching specific materials and manufacturing techniques?

- You are given an estimate of the likely sales volume – what does this tell you? What manufacturing techniques will suit this sort of volume? Research some of these techniques.
- You are told you will be leading the design on the engine mount. Make sure you understand what the mount does, how an engine might be connected to it and how it will connect to the aircraft.
- You are also told that rigidity is likely to be an issue. Could you improve the rigidity of the engine mount by using different materials or a different geometry? Research this and find out ways to make a structure rigid. Vibration could also be a concern – this can cause cyclic loading and so fatigue might be a worry. Research the sorts of materials and features that can make fatigue more likely. Also remember that you are designing for an aircraft, so consider what other constraints there might be on any parts.

The set task

The case study outlined a scenario in which your company wishes to move into a new market for more powerful drone aircraft. A new range of aircraft models and components must be developed to meet this need.

Your current engine mounts are made from folded sheet aluminium, but they lack rigidity and can vibrate excessively. It is recognised that you will not be able to use these existing mounts on the new drones with their more powerful engines and the high expectations of your professional users.

Your role as a design engineer is to develop an effective engine mount for the new drones, which are intended to be high-quality professional aircraft and will be expected to provide many years of reliable service.

It is expected that the engine will need servicing over time and that it ought to be possible to carry out routine servicing with the engine in place, but that engine removal should also be possible for more comprehensive overhaul.

You are expected to produce a redesigned engine mount for use in the drone aircraft.

You will need to record your design planning, design decisions, concepts, drawings, and so on in your task book, which will be taken in for assessment.

Client brief

Your company has surveyed 16 potential customers regarding how important they think various aspects of the drone are (see **Table 3.17**). For each factor they were asked to score the importance out of 5, with 5 representing high importance and 0 meaning of no importance.

Table 3.17 Customer survey scores

	Customer															
Factor	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Reliability	5	3	3	5	5	3	2	5	5	5	3	4	4	4	3	5
Ease of use	2	3	4	1	5	4	3	2	5	4	3	2	3	4	3	4
Low price	1	2	3	2	1	4	3	2	1	1	2	3	2	3	2	3
Advanced functions	1	2	1	1	1	2	2	1	0	2	5	5	1	1	2	4

Here are some details about the engine in the new drone:

- four-stroke air-cooled petrol engine
- volume 30 cc
- maximum output 2.68 HP/9000 rpm
- weight 1400 g including exhaust.

Details of the locations of the mounting holes for the interface with the engine and the bulkhead can be seen in the diagrams (**Figure 3.31**).

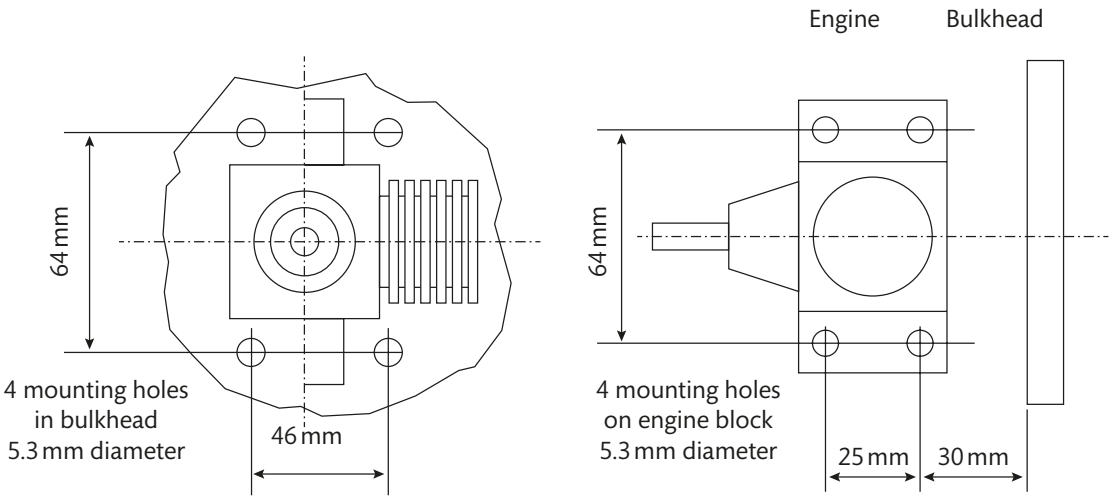


Figure 3.31 Diagrams of the engine mount, showing dimensions and the locations of the mounting holes

Activity 1

At the start of the task, create a short project time plan in your task book. During the development process you should also record:

- why changes were made to the design during each session
- action points for the next session.

Total for Activity 1: 6 marks

Activity 2

Interpret the client brief into operational requirements, which should include:

- product requirements
- opportunities and constraints
- interpretation of numerical data
- key health and safety, regulatory and sustainability factors.

Total for Activity 2: 6 marks

In this activity you demonstrate that you understand what your product needs to do. It can help to break the requirements down into key general areas and identify other more specific criteria within each area.

- Physical requirements:
  - must securely support engine
  - must utilise standard engine and bulkhead screw locations
  - must attach to the aircraft via a bulkhead
  - must transfer propellor thrust from engine through to aircraft
  - must dampen vibration from engine
  - must …

In the real assessment you will have a set period of time to complete the entire task, spread over a number of sessions. You will only be allowed a limited number of notes you prepared earlier. Try to limit yourself to using what you have on these sheets and in your head. In the supervised assessment sessions you will not be able to carry out any additional research.

Read ahead carefully to see what you will be expected to do over the entire assignment, and divide up your time accordingly. Your tutor should give you the schedule for your sessions, so use this information to organise your time.

- Assembly and servicing requirements:
  - must allow for efficient assembly
  - must allow for easy removal of engine
  - must allow for easy access to serviceable and adjustable elements of engine.
- Manufacturing requirements:
  - must be cost-effective to manufacture
  - must be easy to assemble if produced from multiple parts.

Refer back to Section B1 for other general areas to consider.

Look at the data collected from users (such as the information in **Table 3.17**). Plot the data in an appropriate graph or complete some other statistical analysis to get a feel for what your customers want from the product. For example, you may find the customers value reliability more than a low purchase price.

You also need to consider other constraints. For example:

- The engine mount is to go in a small, unmanned aircraft, so weight is likely to be a key factor.
- The mount may also be subject to fuel and oil splashes, as well as the possibility of rainwater, so you may wish to include relevant constraints.
- The mount needs to be safe – failure in use or during start-up could cause injury to users.

On completing this activity you should have formulated a clear description of what is required of your product, and this should be referred to continually as you develop your design proposal.

Activity 3

Produce a range of initial design ideas based on the client brief, to include:

- sketches
- annotations.

Total for Activity 3: 9 marks

Try to generate as many different concepts as you can, with supporting sketches or drawings. Use morphological analysis (Section C1) to help you if you're struggling to come up with ideas, or try imagining how you might make the mount if it were to be cast, machined, moulded or assembled.

Make sure that you add notes to each concept you have generated to draw out the key features of the proposal. Focus on getting the idea across and do not worry if your sketches lack polish.

Activity 4

Develop a modified product proposal with relevant design documentation. The proposal must consider:

- a solution
- existing products
- materials
- manufacturing processes
- sustainability
- safety
- other relevant factors.

Total for Activity 4: 30 marks

From your two or three best concepts, decide which one you will take forward as a formal proposal. Try using a weighted matrix evaluation, comparing each proposal against key design criteria. Make sure that you can also justify why your design is better than the existing product.

Write your explanations and justifications down in your task book. It should be clear to someone reviewing your work why you chose the approach you did.

Think carefully about the material you will use for making the mount – this will have functional, manufacturing, cost and sustainability implications. Your documentation should show clearly that you have considered these implications and can justify your choice of material.

The basic concept is likely to need some work to turn it into a product that can be produced commercially in the required numbers. One option that could be viable for the mount is to use casting or moulding, in which case you would need to consider draft angles and the way the mould is split.

This activity is worth half the total marks for the assessment, so make sure you do it as completely and correctly as you can. The end result should include a detail drawing (or drawings) of the part, with all key dimensions marked, a material specified and a plan for manufacture. Don't forget to consider the end-of-life options for the drone and your mount. What will happen to it? Will the part be easy to remove? Can it be recycled?

Activity 5

Your final task book entry should evaluate:

- the success and limitations of the completed solution
- the indirect benefits and opportunities
- the constraints
- opportunities for technology-led modifications.

Total for Activity 5: 9 marks

Review your proposal against your design specification. Be clear about where you think it has succeeded, but also be honest about where you think it may be more marginal or where conflicting constraints could not be resolved as well as you would have liked.

See if you can think of any indirect benefits of your design. For example, it may be that the design of the mount enables a range of engines to be accommodated, simply by placing the mounting holes in slightly different locations.

What constraints still exist? For example, in this brief you were asked to design an engine mount, but by looking at the drone as a whole it might be that a separate engine mount is not needed and it can instead be made an integral part of the aircraft fuselage.

Could there be opportunites for a more refined design if new materials become available?