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# Moderators' Report/ Principal Moderator Feedback

## Summer 2015

## Pearson Edexcel GCSE in Manufacturing

## 5MN01 Paper 01

## Designing Products for Manufacture

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Summer 2015
Publications Code UG042052

**Unit 5MN01**

**Designing Products for Manufacture**

**General Comment**

This was the fifth year of assessment for the specification. Centres submitted evidence from a range of different manufacturing sectors.

The starting point for this unit is the design brief provided to students. Careful consideration must be given by centres to formulating the design brief. This year it was observed scale of production required in the design brief in some instances added an unnecessary level of complication to the task. For example, the complexity of designing for manufacture an artefact with a production run of 100,000 is potentially significantly more complex than that associated with a batch of 10, or a one-off prototype. Centres should consider the implications of a brief linked to scales of production beyond those that can reasonably be evidenced by GCSE-level learners.

Centres should also consider how the requirements provided in the design brief will be used by learners. If the brief contains requirements that would be difficult for learners to evaluate objectively, the merits of their inclusion should be considered. For example, while learners could objectively measure the weight of a prototype with relative ease, it would be considerably more complex to objectively measure the aesthetic appeal of a prototype designed for a specific audience.

Design briefs should be structured so that learners operating at the lower performance levels are guided towards producing appropriate evidence, while those operating at the higher levels have sufficient opportunity to demonstrate independence.

Quality of Written Communications (QWC) is assessed in 6 out of the 8 criteria but was rarely referred to specifically by centre staff. Assessment of QWC considers students' abilities to:

1. Write legibly, with accurate use of spelling, grammar and punctuation in order to make the meaning clear.
2. Select and use a form and style of writing appropriate to purpose and complex subject matter.
3. Organise relevant information clearly and coherently, using specialist vocabulary when appropriate.

Most centres provided clear photographic evidence to support the award of marks. Photographic evidence is particularly useful for the following assessment criteria:

e) Testing and selecting the final solution
f) Prototype
g) Presentation techniques

The quality of witness statements were variable. When high quality witness statements accompany students' work, marks from the higher ranges were regularly accessed. Where witness statements were generic, lacked detail

or simply were not provided, it was unlikely that the more ephemeral skills such as independence would be sufficiently evidenced for the high marks to be justified.

An example of a high quality witness statement is shown below. The statement is to support marks awarded for criterion F 'Prototype'. Student names have been replaced.

*The student was very independent and confident in her selection of tools and equipment for the manufacturing of her layered slice prototype.*

*Equipment used included weighing scales, a bain-marie, bowls, cooks knife, baking tins, use of an electric oven ,saucepans and a cooling wire. The student was very careful not to burn the butter, syrup and sugar mixture when melting them for the Flapjack layer as she was aware this could occur quite easily.*

*The student used tools and equipment with skill and with the correct techniques, enabling her to successfully produce a high quality batch of twelve almost identical slices that met the design brief.*

*The student used a food ruler to ensure they were the correct dimensions and skilfully applied the surface decoration which showed quite a strong link to the Olympic games.*

*The student was confident and independent during the manufacture of the prototype. She did not require any assistance. She also followed all of the safety rules including wearing an apron and using oven gloves when required. She kept her work area clean and clear of clutter at all times.*

An example of the type of witness statement that does not support the award of marks is shown below.

*John worked with some skill and independence. For this reason Phillip is awarded full marks.*

Where the same witness statement is repeated for all learners, with only the name changed, there is an increased potential for moderators not to agree centre awarded marks.

The maximum score for unit 5MN01 is 50, and this unit carries 30% of the overall assessment weighting for the GCSE Manufacturing Double Award.

**Administration**

Most centres addressed all aspects of administration thoroughly.

A variety of A4 and A3 sheets of paper and card were submitted, with many different types of binder being used. Centres should encourage candidates to use A4 sheets, preferably in portrait mode, with each portfolio fastened together using a single treasury tag through the top left-hand corner.

In most cases samples were well organised and a Controlled Assessment Record Sheet had been completed for each candidate, giving a list of marks.

**Assessment**

Centres made good use of the expected evidence detailed in the teacher support book. Where there was a clear link between expected evidence, student work and teacher assessment, students were able to access the full range of marks available. Where the expected evidence is absent from learners' work, it is unlikely they will achieve marks from the higher ranges.

Witness statements were used effectively by most centres. Assessment grids contain 'with limited guidance', 'with guidance', or 'worked independently', etc. and require a teacher witness statement and/or comments to help a remote moderator agree the score awarded. Depending on what is being assessed, it is important that witness statements or observation reports are completed by teachers to authenticate candidates' work and provide evidence that candidates have achieved the level of performance required by the assessment grid.

The following comments relate to specific criteria:

***Criterion (a)*** - Analysing the brief

Most centres included a copy of the design brief given to students with the moderation samples.

Typically those candidates that scored the higher marks presented their evidence split into two sections: client needs and key features of the product. These were then broken down into the following sections:

Client needs:
- cost
- quantity required
- intended market
- timescales
- product function

Key features of the product:
- styling
- aesthetics
- size (with tolerances)
- quality standards
- performance

As commented on in the previous section, there were some instances where the design brief did not make it explicit to students if they were to consider designing for a prototype or a mass produced product. This tended to result in students attempting to produce evidence beyond their expected capacity. For example, while it may be reasonable to suggest that a client would want 10,000 artefacts to be produced, it would be unreasonable to expect typical

Key Stage 4 students to be able to analyse how long each stage of the commercial production process would take.

Centres might consider focusing different elements of their design brief towards different scales of production. For example, students could be asked to consider manufacturing processes for both their own prototypes (as they will produce for criterion f) and the client's final commercial product.

***Criteria (b) and (c)***

Most centres separated 'design specifications' from 'manufacturing specifications'. The details given in the client brief are key to candidates' performance. Where the brief lacks detail, it will be difficult for students to access the higher marks available.

**Criterion (b)** - Product criteria and material constraints

For the product criteria, candidates need to consider:
- Product performance
- Intended markets
- Maintenance
- Size (with tolerances)

For the material constraints, candidates need to consider:
- Materials and their availability
- Material properties, characteristics and performance
- Material cost
- Regulations
- Handling and storage
- Health, safety and hygiene
- Scales of production
- Quality standards
- Limitations of available tools or equipment

The level of detail candidates provide in this criterion will have a direct link to subsequent criteria d, e and h. During the moderation process, the following observations were made about the above factors:

- Size (with tolerances)
  Tolerances should be appropriate to the manufacturing methods being considered. Where CNC equipment, such as laser cutters, is being considered, tolerances of fractions of a mm would be more appropriate than several mm.
- Regulations
  This is another area where the level of detail in the client brief, and the nature of the product being considered, to a large extent control the candidates' ability to offer relevant information for this topic. Where candidates were observed to be successful, the associated client brief tended to give specific areas for them to research. For example, a client brief that suggests regulations required by the Food

Standards Agency must be followed might guide candidates to research The Food Standards Act 1999.

**Criterion (c)** - Production requirements and quality standards

For the production requirements, candidates need to consider:
- quantity being made
- size
- weight
- cost
- time to manufacture

For the quality standards, candidates need to consider:
- tolerances (which relate specifically to those in the preceding criteria b)
- material specifications
- finish
- performance and requirements – with reference to the client's needs.

Access to the higher mark ranges depends on the candidates' ability to demonstrate a more in-depth understanding of the factors being considered, not simply the amount of evidence presented.

A candidate that produces a list, for example, of 20 factors related to the cost of the product is not demonstrating the ability to describe, or explain, as required to access the higher mark ranges.

The example below is intended to illustrate the type of progression expected:
- For a list:

*The calendar should sell for £1:50.*
- For describe:

*The calendar should sell for £1:50. From my research I have found that this is the typical cost of similar products on the market.*
- For explain:

*The calendar should sell for £1:50. From my research I have found that this is the typical cost of similar products on the market. This price is also reasonable because it would allow for a 25% profit based on the expected costs of the materials.*

Centres might consider if the resources published by the British Standards Institute would help their learners produce valid evidence for quality standards. The education branch of the organisation publishes materials prepared for students, including some specially for GCSE Manufacturing. These are available from http://www.bsieducation.org/Education/14-19/default.shtml

For example, information is provided on food packaging as shown below:
*"The way food is presented and packaged can heavily influence a customer's decision. But first and foremost, food packaging has to keep a product safe and fresh. It is, therefore, important which materials are used. Toxic or inappropriate materials shouldn't be used, such as a leaking cardboard box. To ensure this doesn't happen, Standards are needed"*
http://www.bsieducation.org/Education/14-19/food-packaging/default.shtml

**Criterion (d)** – Ideas and design solutions

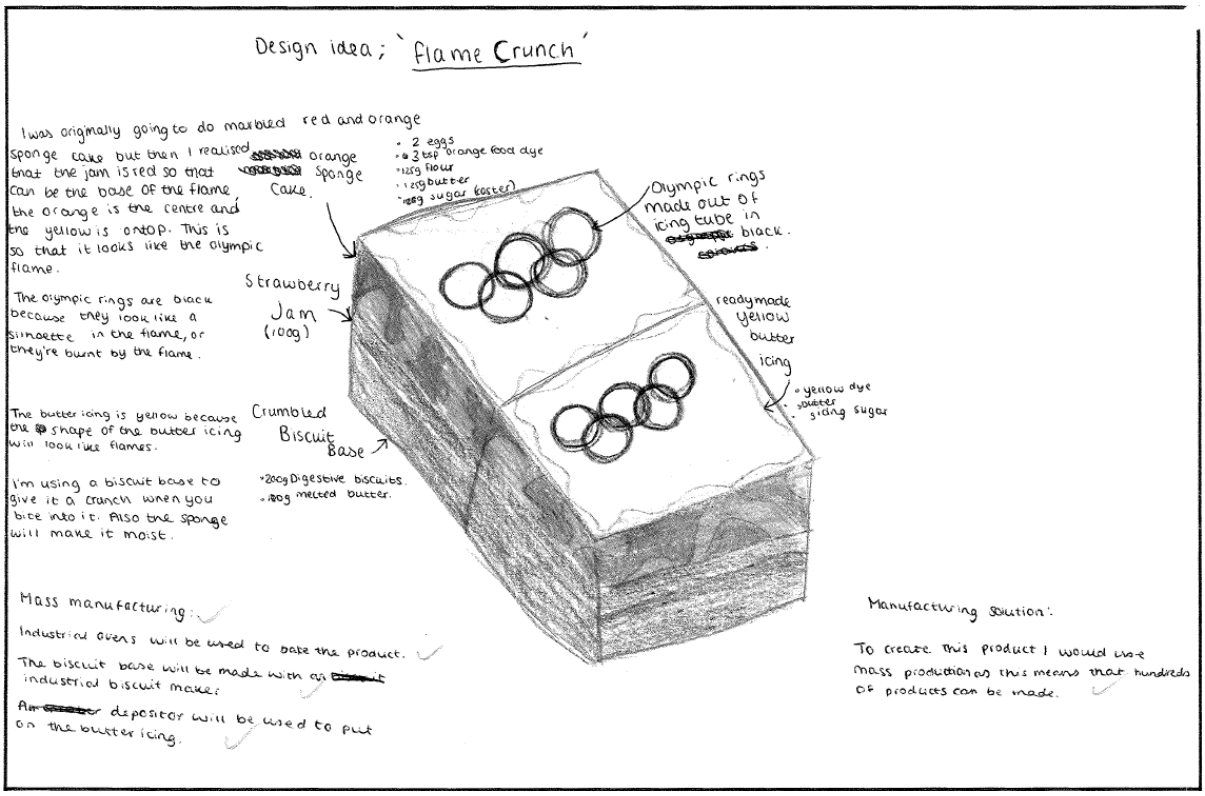
During the moderation process it was evident that some centres had failed to expect their candidates to address both parts of the assessment requirements for this criterion. While all candidates provided evidence of the generation of design ideas, a number did not address the need to show explicit consideration of how the product would be manufactured. The information provided in the publication *Manufacturing Controlled Assessment Teacher Support Book 2012* clearly states: "this is 'Design for Manufacture' both elements must be evidenced – design ideas and the manufacturing of these ideas. If only design ideas are produced, the maximum mark for this criterion is 3".

While candidates are developing their design ideas they should consider, and make comments about, how their proposals achieve the client's requirements and the specification points from criteria b and c.

Typically, where candidates only accessed the lower mark ranges this was due to the combination of a lack of detail in their ideas and a lack of information about how the design would be manufactured. Centres should be aware that while carefully produced, high quality rendered drawings that show the appearance of the design proposal are commended, they may not fully address the requirements of the assessment criteria. Marks are allocated based on the candidates' ability to demonstrate their knowledge of design for manufacturing, not their ability to draw.

Candidates should be made aware that repeating the same comments about manufacturing for each of the different proposals is unlikely to gain them more marks.

Below is an example of learner work which illustrates how design for manufacture can be considered. The drawing and notes provide information about appearance, size, materials, tools and processes.




**Example of a design for a manufacturing idea produced by a candidate**

**Criterion (e) -** Testing and selecting the final solution

In order to access the marks available from the higher ranges, candidates need to provide evidence of:

- Objective testing against the design criteria which gives rise to measurable results.
- Selecting a final design and justifying this choice with reference to design criteria, client needs and specification.

Learners should provide evidence to support the results of their tests. The example below, reproduced from a candidate's portfolio, is considered. The design brief required the learner to design for manufacture a child's toy.

| | What is being tested | Test | Result |
|---|---|---|---|
| 1 | The product must be small enough to be able to fit In someone's hand with minimal effort. | The product was tested with a select group of people with different hand sizes. | The product fits easily in an adults hand however it fits in two hands of a child but It is still light enough to be held with minimal effort. |
| 2 | The product must follow the BSEN 71.1 standards | I will check the BSI website and check the materials I have used against this. | The materials I have used on my product are in check with BSEN 71.1 standards and are safe to use |
| 3 | The product must cost less than £3.50 to manufacture | | The total cost to manufacture my product is **f** 2.36 which is £ 1.14 under the budget |

Test number 1
In the context of the product this test was a useful and valid one to complete. Had the learner recorded the tests being completed photographically the moderator would have been able to give greater credence to the testing process. Without this evidence the learner's comments could be considered as a proposal for testing, rather than results of actual tests.

Test number 2
Again this test is potentially useful and valid. As the learner has not indicated what specific checks were undertaken, this type of evidence can only be considered as a proposal for a potential method, not as evidence of a test being undertaken.

Test number 3
As with the previous two examples, this would be a valid test. In this instance the learner provided no evidence to support how the cost of £2.36 for manufacture was determined. Had even rough estimates been provided that illustrate how this figure was determined, the evidence would have had much more credibility.

**Criterion (f)** – Prototype

This criterion requires candidates to provide evidence that they have:
- Selected appropriate processes, tools and equipment.
- Used these with skill and accuracy.
- Used these in a safe and independent manner.

As much of this type of evidence is ephemeral, centres need to consider how they will evidence the marks they award. Where centres provide no explicit evidence to show why the marks were awarded, there is a higher potential for the moderator not to agree the assessor's grading decisions.

Typical evidence that was provided by centres whose candidates accessed the higher mark ranges included:
- Manufacturing plans
- Annotated photographs of the candidate using tools, processes and equipment
- Annotated photographs showing key features of the prototype that could only have been achieved through the application of skill and accuracy
- Witness statements, or observation records, that make specific reference to how the candidate demonstrated independence and safety.

Successful manufacturing plans included details of the following:
- materials, parts and components to be used
- processes to be used
- tools, equipment and machinery to be used
- timescales
- health, safety and hygiene factors.

The teacher's guide contains the following comments about witness statements "Note: avoid 'judgemental or evaluative statements'. For candidates, and witness statements, it is essential to include real details; saying 'appropriate tools', etc, or 'worked skilfully and safely', is not reporting or stating what was witnessed".

Below is an example of a witness statement of the type that potentially does not provide sufficient detail to agree marks from the higher ranges:
*The students prototype manufacture encompassed and range of techniques including: Marking out, cutting, smoothing, drilling, 2D design, Laser cutting, engraving, adhesives and template use. The student was able to carry out all techniques independently, with skill and accurately with no teacher support except for use with the laser cutter, school policy dictates teacher supervision whilst this is being used. The student followed all H&S expectations using the correct PPE where necessary.*

Note spelling and grammar have been copied from the original document.

**Criterion (g)** – Presentation techniques

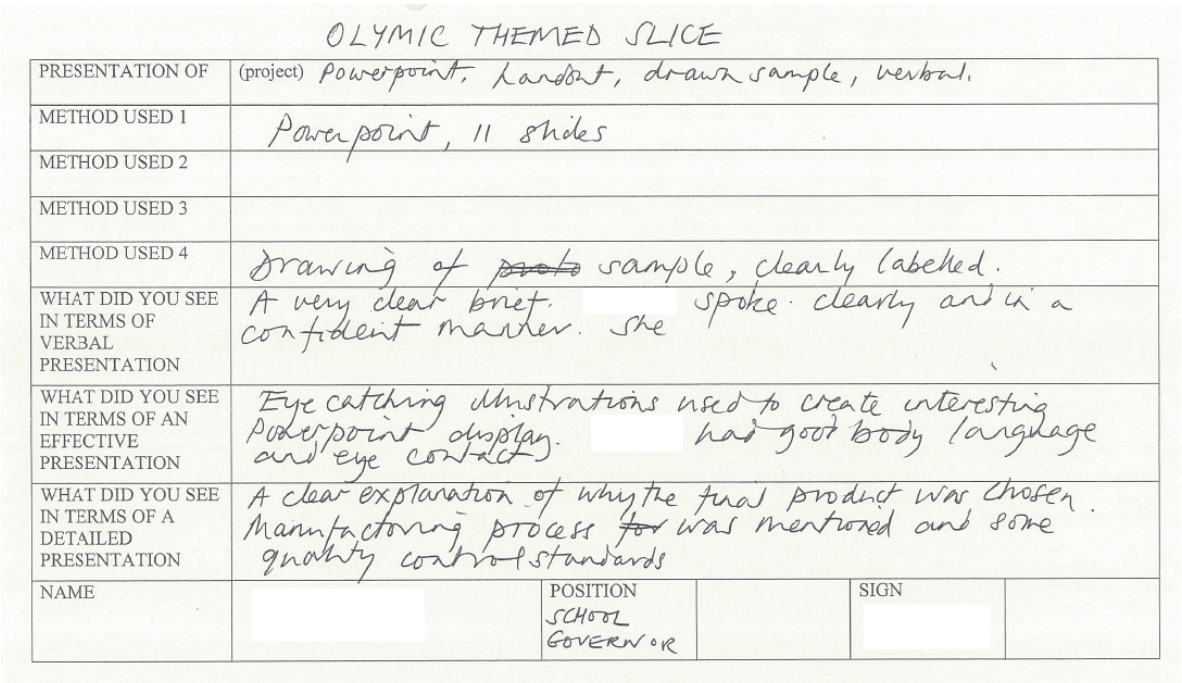
In order to access the marks available from the higher ranges, candidates need to provide evidence of:

- justifying how and why the range of presentation/communication techniques were selected
- showing that the presentation was carried out effectively and in detail.

A range of approaches were used by centres to evidence candidate achievement in this criterion. In order to achieve the first requirement, a common approach that was successful involved candidates producing a table that considered the merits of a range of presentation techniques.

The teacher support booklet provides more detail about the expected range of evidence for this criterion, which centres should make sure they are familiar with.

The second element of the criterion requires a presentation to be delivered, either to a group, or an individual, such as the teacher. Where centres provided observers with a template to record their assessment of the presentation, clear evidence was often generated to support the award of high marks. An example of this type of recording is shown below.



OLYMIC THEMED SLICE

| | | | | | |
|---|---|---|---|---|---|
| PRESENTATION OF | (project) Powerpoint, handout, drawn sample, verbal. | | | | |
| METHOD USED 1 | Powerpoint, 11 slides | | | | |
| METHOD USED 2 | | | | | |
| METHOD USED 3 | | | | | |
| METHOD USED 4 | Drawing of ~~photo~~ sample, clearly labelled. | | | | |
| WHAT DID YOU SEE IN TERMS OF VERBAL PRESENTATION | A very clear brief. [redacted] spoke clearly and in a confident manner. She | | | | |
| WHAT DID YOU SEE IN TERMS OF AN EFFECTIVE PRESENTATION | Eye catching illustrations used to create interesting Powerpoint display. [redacted] had good body language and eye contact. | | | | |
| WHAT DID YOU SEE IN TERMS OF A DETAILED PRESENTATION | A clear explanation of why the final product was chosen. Manufacturing process ~~for~~ was mentioned and some quality control standards | | | | |
| NAME | [redacted] | POSITION SCHOOL GOVERNOR | | SIGN | [redacted] |

***Criterion (h)*** – Final review

In order to access the higher mark ranges, candidates need to seek feedback regarding their design proposals from a client. The evidence required, again as described in the teacher guide, consists of two parts:

- A separate description or detailed explanation of how the final solution meets the brief and specification, including details of any earlier modifications.
- Identification and description/explanation of further modifications which would be made following the client's feedback.

While most learners provided appropriate evidence for the first requirement of the criterion, the second was less well addressed. The focus should be "further" modifications, not a record of modifications already incorporated in the design proposal. An example of learner evidence that illustrates this issue is shown below:

*"Modifications*
*Since I started to manufacture my product I have encountered some minor design changes on my product. One of these changes is the way the base on my product is connected to my main frame; it started off as a plug fit however when I made the plug fit it was not a very secure fit so I decided to change the design to a recess which made it much more secure without compromising the design to greatly. The second and final change I have made is that I have decided to get rid of the idea of creating a connect four game to go with the checkers board I have already manufactured however I had a lot of difficulty putting my idea into a product so therefore I had to leave that idea."*

Example of possible content for a high grade project

| Criterion | Typical content |
|---|---|
| A - Analysing | There will be complex sentences explaining the client needs relating to cost, quantity required, intended market, timescales and product functions.<br>There will be similar evidence linked to the key features of the product being designed. Information about quality standards will be specific. |
| B – Spec, product / materials | Learners will typically provide several sentences that explain each of the following: intended markets, and size, product performance and maintenance. An explanation sentence will typically have the format of "this is required because of this". For example: "The battery must be easy to change because users will become annoyed if it is difficult. Also if it was difficult to change, the user may damage the clock".<br>Several sentences will be written that describe a material's availability and its characteristics/properties. These sentences will be based on actual availability in the centre, and not some generalisation such as "easy to get hold off".<br>There will be sentences that describe some aspect of safety. |
| C – Spec production / quality | Learners will typically provide sentences that explain the quantity being made, physical features such as size/weight, costs, and time to manufacture. This may essentially be new information from criterion B. Statements about relevant quality standards will be specific. For example, the rear lights of bicycles must comply with BS 6102-3. This would require that "If capable of emitting only a flashing light, it must emit at least 4 candela" |
| D - Ideas | There will be several sketches, that show some aspects of detail. These designs will show a degree of "flair" or imagination. There will be evidence of different processes that may be used to realise the product; these will contain some accurate/relevant details. |
| E - Testing | There will be photographic evidence of the production of a model. This will be annotated to explain the what is being determined by the test. Testing of different aspects of performance will be undertaken, and recorded<br>Using the results from testing and other relevant information, learners will compare their selected design solution to the design brief and justify the reasons for choosing the preferred design and rejecting the alternatives. |
| F - Prototype | The learner will produce a prototype that reflects the results from testing. This will involve the use of a range of processes, tools and equipment.<br>There will be detailed witness statements made that indicate high levels of skill, safety and independence. The learner will provide detailed evidence to support safety. Photographic evidence will clearly show a well-made, accurate prototype. |

| | |
|---|---|
| G - Presentation | There will be evidence of consideration of a range of presentation techniques and the relative merits of each one. There will be evidence that a presentation took place – typically this may be the inclusion of a PowerPoint presentation. This PowerPoint will be detailed, showing all the key aspects of the project. There will be witness statements that support the effectiveness of the presentation. |
| H - Review | There will be a portfolio that serves as a presentation document that contains materials of a “good” quality. The final design solution will be reviewed against the brief. There will be several modifications described, probably by use of drawings, and these will be explicit. It will be clear how these modifications would improve the performance of the product. |

**Grade Boundaries**

Grade boundaries for this, and all other papers, can be found on the website on this link:
http://www.edexcel.com/iwantto/Pages/grade-boundaries.aspx

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