



HM Government

**T-LEVELS**

**T Level Technical Qualification in  
Engineering, Manufacturing,  
Processing and Control (8713-33)**

**Composites Manufacturing  
Technologies (333)**

**Guide Standard Exemplification  
Material**

**Threshold Competence – Sample  
2022**



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Version 2.0**

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2.0 Feb 2024	Minor typographical amendments	Through document
	Evidence requirements clarified	Task 1, 2a and 2b

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## Introduction

The sample assessment materials within this document refers to the Composite Manufacturing Technologies sample occupational specialism assignment. The aim of these materials is to provide centres with examples of knowledge, skills and understanding that attest to **minimal threshold competence**.

The examples provided do not reflect all evidence from the sample assignment as the focus of this material is the quality and standards that need to be achieved rather than the volume of exemplar evidence provided. However, the examples provided are representative of all tasks in the sample assignment. The evidence presented here has been developed to reflect **minimal threshold competence** within each task but is not necessarily intended to reflect the work of a single candidate. It is important to note that in live assessments a candidate's performance is very likely to exhibit a spikey profile and the standard of performance will vary across tasks. Minimal threshold competence grade boundary will be based on a synoptic mark across all tasks.

The materials in this Guide Standard Exemplification Material (GSEM) are separated into the sections as described below. Materials are presented against a number of tasks from the assignment.

### Task

This section details the tasks that the candidate has been asked to carry out, what needs to be submitted for marking and any additional evidence required. Also referenced in this section are the assessment themes the candidates will be marked against when completing the tasks within it. In addition, candidate evidence that has been included or not been included in this GSEM has been identified within this section.

In this GSEM there is candidate evidence from:

- Task 1 - Planning
- Task 2 - Production
- Task 3 - Quality review and evaluation.

### Candidate evidence

This section includes exemplars of candidate work, photographs of the work in production (or completed) and practical observation records of the assessment completed by centre assessors. This will be exemplar evidence that was captured as part of the assessment and then internally marked by the centre assessor.

Photographs in this GSEM demonstrate the full process that the candidate has undertaken to complete the spacer block assembly. Commentary sections detail where performance is considered to be at a level reflective of a threshold competence grade. Note, due to the nature of this process, not all individual work activities would provide opportunity to demonstrate a defined level of differentiation beyond a pass – but these images are shown in order to show the cohesiveness of the process being undertaken, and to draw out where differentiation is possible.

## Commentary

This section includes detailed comments to demonstrate how the candidate evidence attests to the performance standard of **minimal threshold competence** by directly correlating to the grade descriptors for this occupational area. Centres can compare the evidence against the performance indicators in the marking grid descriptors within the assessor packs, to provide guidance on the standard of knowledge, skills and understanding that need to be met for **minimal threshold competence**.

It is important to note that the commentary section is not part of the evidence or assessment but are evaluative statements on how and why that piece of evidence meets a particular standard.

## Grade descriptors

**To achieve a pass (threshold competence), a candidate will typically be able to:**

Interpret information, plan, assess risk and follow safe working methods when applying practical skills to an acceptable standard in response to the requirements of the brief.

Adequately prepare working areas, acknowledging potential risks and applying acceptable housekeeping techniques during tasks.

Demonstrate basic technical practical skills in preparing moulds, shaping composite materials and cores, laying-up, debulking, consolidating, curing and de-moulding, assembling and finishing that are in line with industry standards and meet the requirements of the brief.

Adequately demonstrate ability to follow laminating and assembly procedures to produce composite components to meet the requirements of the brief.

Demonstrate basic knowledge and understanding of the principles and processes required for composite engineering to produce a product that meets the required tolerances within the brief.

Work safely showing an understanding in the selection and use of relevant tools and equipment and demonstrate a basic awareness of straightforward preparation and application processes within the working environments for preparing moulds, shaping composite materials and cores, laying-up, debulking, consolidating, curing and de-moulding, assembling and finishing composite assemblies.

Identify causes of problems or common issues related to production control, operating procedures and quality control and have some knowledge and skills in how to rectify them.

Mostly use general industry and technical terminology accurately across different communication methods with some consideration of technical and non-technical audiences.

## **Task 1 – Planning**

**(Assessment themes: Health and safety, Planning and preparation)**

For task 1 candidates need to produce the following pieces of evidence:

- a resources list with justifications for the selections, and measuring equipment calibration check results recorded
- a risk assessment
- a method statement with justifications
- a quality check sheet (for use in task 3b).

For task 1 candidates will be expected to produce a quality check sheet to use in task 3b during the quality inspection task. This is supporting evidence for assessors to gauge the candidate's planning skills and will not be marked.

## Candidate evidence

### 1. Resources list with justifications for the selections, and measuring equipment calibration check recorded

Requirements and resources	Quantity	Justification
<b>Tools/equipment/materials/consumables</b>		
Pen and paper	N/A	To plan my work and add notes needed for my job.
Mould tool	1	The mould tool makes the moulding to the right shape.
Mould tool scraper	1	The mould tool will have resin left on it from other moulding work so this needs to be scrapped off.
Mould tool cleaner	1	To clean the mould.
Release agent	1	The carbon fibre will stick to the mould if it is not treated with a release agent.
Pre-preg carbon fibre 2x2 twill weave	800mmx400mm	To use to build the laminates.
Marking out equipment	1 of each	So that I can cut my plies in the correct way according to the drawings in the assignment.
Cutting tools to cut material used	1	I will use a pair of scissors to create a rectangle or pre-preg and then I will mark out the plies and cut them with a sharp knife.
Core material	51mmx121mm	I need to cut a section of core material and then shape it to meet the dimensions.
Moulding tools (Knerkers and rollers)	2	Tools to ensure that the plies are pressed onto each other, that there is no air between the plies.
Peel ply film	Roll	I will use peel ply to ensure that the rest of the consumables do not stick to the moulding.
Breather fabric	Roll	I will use this to make sure that the air gets sucked out of the moulding.
Bagging film	Roll	This is needed to form a vacuum inside the bag so that consolidation occurs.
Tacky tape	Roll	Tacky tape is used to seal the vacuum bag.
Vacuum Breach Unit (VBU)	1	This allows the vacuum hose to be connected to the bag.
Pressure gauge	1	This allows me to measure the vacuum and see that it does not drop too much.
Oven	1	The oven allows me to set the temperature and time that the moulding and mould will be cured for.

Wedges	1	I will need to lift the moulding out using a wedge inserted at the edge.
Bonding glue	1	Epoxy adhesive that will be mixed and applied to the prepared surface.
Clamps	4	These make sure the upper and lower parts are bonded together.
Measuring equipment	N/A	The measuring equipment is used to measure the part and make sure the specification and dimensions are correct.
Computer access	N/A	To prepare the report for handover.
<b>Personal Protective Equipment (PPE)</b>		
Gloves	2 pairs	Needed to protect my hands when working with composite materials and substances.
Safety boots or safety shoes	1 pair	Needed to prevent injury to feet if any objects are dropped.
Coveralls	1 pair	Needed to protect my clothes and prevent outside dirt from affecting the laminating process.
Safety glasses	1 pair	Needed to protect my eyes from dust and debris.
<b>Technical Information/documentation</b>		
Assignment brief	Needed for the technical drawings and tolerances.	
Calibration record	Needed to check that the equipment used is within calibration date.	
User manuals	Needed for the operation of the oven.	
Risk assessment	To be completed before beginning the task to identify risks and hazards that may occur during the activities.	
Material Safety Data Sheets (MSDS)	Details what PPE to wear to protect myself and others whilst using the specific material.	
Material Technical Data Sheets (TDS)	This document describes how to handle materials, and what they do.	
Quality check sheet	This is a document that I use to record the results of the quality check and check what I have produced meets the specification.	
Method statement	This document sets out what I need to do and in the order in which to do things for the tasks.	
<b>General Workshop resources</b>		
Waste disposal bins	Waste to be separated for correct disposal.	
First aid kit	In case of any minor injuries.	
Warning signs and notices	In case of a spillage, to warn others of a wet floor	
Mop and bucket	To clean up any spillages and clean the work area once job has been completed.	
<b>Calibration of measuring equipment</b>		
All measuring equipment has been checked for calibration against the workshop record. Last calibration date was November 2022.		

## Commentary

The candidate has interpreted the requirements of the brief and applied their understanding to produce an adequate list of resources required, demonstrating basic technical knowledge of the requirements required for producing the composite assembly.

The candidate has listed amounts of each resource that they have planned to use but their justification is brief and not detailed. The candidate could have provided more considered and developed justifications for their choice, providing more detail around the intended use. For example, explanation as to why a mould cleaner is needed to remove the residue when they have already used a scraper. The candidate has indicated the task in which the listed resources will be used. The candidate has also included consideration for other resources that should be available in the workshop, for example, access to a first aid kit. They could have also included an eye wash station.

The candidate has recognised the need to refer to supporting technical documentation in order to complete the task. This is not detailed. The candidate could have developed their response further if they had provided more specific detail on how this information would support them to complete the tasks effectively. For example, the candidate could have listed the measuring equipment they were planning on using and detailing their purpose or provided additional detail regarding the preparation and setting of the oven for the curing process.

The candidate has demonstrated planning for safe working by identifying appropriate PPE and stating why each piece should be used, but some areas lack additional detail, for example, the type of gloves to be worn and why they are the preferred type for the activity. To develop their response further the candidate could have listed additional pieces, including the use of barrier cream to protect the hands from irritants when using chemicals and handling composite materials.

# 1. Risk assessment

## Mould preparation

Hazard	Risk	Control	Likelihood	Severity
Manual handling of moulds, materials and equipment.	Back injuries, sprains.	Ensure training has been given. Use correct manual handling techniques. Use mechanical methods to avoid handling larger and heavier materials. Follow manual handling regulations.	2	3
Allergy to chemicals.	Allergic reaction.	Ask the person if they are allergic before using any chemicals. Wear full PPE when handling chemicals and adherence to COSHH data sheets.	2	4
Use of sharp tools to prepare and clean mould surfaces.	Cuts, grazes, skin injuries.	Use protective gloves and employ safe working practices. Good tool management.	3	2
Exposure to hot surfaces during or post mould preparation and drying.	Burns to hands or other body parts.	Allow moulds to cool before handling. Use heat resistant gloves.	2	2
Dropping of tooling onto body parts and feet.	Feet, fingers or other body parts are crushed by falling moulds.	Wear appropriate PPE at all times including safety footwear. Don't leave tools near edges of benches where they could get knocked off. Good housekeeping and tool management.	2	3

## Production of the spacer block

Hazard	Risk	Control	Likelihood	Severity
Use of sharp tools to prepare and clean mould surfaces or prepare consolidation consumables.	Cuts, grazes, skin injuries.	Use protective gloves and employ safe working practices. Keep fingers behind the blade when cutting. Work slowly.	3	2
Reaction to chemicals or resins.	Allergic reactions.	Limit exposure to chemicals and resins by the use of PPE and adherence to COSHH.	2	3

Exposure to hot surfaces during or post-curing.	Burns to hands or other body parts	Wear heat resistant gloves when handling hot moulds or when using the oven.	2	2
Using tools to remove mouldings from moulds.	Cuts or abrasions	Use safe edge tools and wedges to remove mouldings from tools, wear correct PPE.	3	1
Sharp edges of the cured mouldings.	Cuts or abrasions resulting from coming into contact with sharp edges.	Wear PPE at all times when handling mouldings and safe-edge products at the earliest opportunity.	2	2
Dust formed from removal of material using abrasive processes.	Inhalation of dust, respiratory issues.	Use extractors. Wear correct PPE selected and wear appropriate masks when carrying out abrasion activities.	3	1

Likelihood		Severity	
1	Very unlikely to happen	1	Minor injury
2	Unlikely to happen	2	Major injury
3	Possible to happen	3	Loss of limb
4	Likely to happen	4	Death of an individual
5	Very likely to happen	5	Multiple deaths

## Commentary

The candidate has considered and identified most hazards and risks associated with the composite manufacturing activities to ensure a method of safe working is followed.

To develop the risk assessment further they could show for each hazard a deeper understanding of risks and hazards in the work place to ensure the safety of themselves and others, for example the work area preparation, slips, trips and falls and considering who could be affected.

Control measures are appropriate, however lack detail, demonstrating that the candidate may not have considered a variety of scenarios and situations that could arise during the manufacturing activities. They have demonstrated acceptable knowledge for risk mitigation techniques to work safely but would need to add further detail into their risk assessment to develop the response further. For example, reporting any broken tools or equipment, performing a visual inspection on hand tools as a control measure.

The candidate has labelled the likelihood and severity for each risk and hazard, although not fully accurately, demonstrating the candidate has an acceptable standard of understanding

and awareness of risk assessment and mitigation, and therefore safe to work. The candidate has demonstrated a basic knowledge for the risk assessment process through the completion of the risk assessment.

The candidate would need to demonstrate a deeper understanding of likelihood and severity by rating them more accurately and that risks can be very unlikely to happen but be of a higher severity rating if it did occur. The candidate has incorrectly given a severity rating of 3 for reactions to chemical and resins which should be rated 1 or 2 as for severity, depending on the severity of the exposure, as this would lead to a major injury rather than a loss of limb.

# 1. Method statement

## ***Method statement – Spacer block assembly***

1. Review health and safety, consider the task and create a risk assessment to ensure compliance with safe practice and use control measures to reduce the risk of harm, for the completion of the tasks.
2. From the brief, I will identify the stages of the task activities that require protective equipment and select PPE that is required to be worn, in order that the tasks can be completed with minimal risk. I will complete a list of materials that will be required to complete the assembly and I will identify the waste disposal methods. I will create a quality check sheet to record the results of the spacer block assembly during the quality review (at the end of the manufacturing process).
3. To produce the spacer block assembly to the given specification I will need to follow a series of composite manufacturing processes. I will work safely, following the risk assessment and method statement. Firstly, I will need to create the spacer block component, then assemble the components to create the final assembly.
4. I will clean and prepare my work area. I will select a suitable mould from the stores and check the surface of the mould is flat and free of any surface scratches or faults will not be removed with cleaning. I will clean any leftover resin residue or dirt from the mould using a scraper before cleaning the mould with a proprietary cleaner. I will apply the cleaner as per the instructions, for the duration needed and repeat to ensure the mould is clean. I will place the clean mould in a clean area ready for the laminating process.
5. I will change into clean PPE, check the brief to understand which composite material is required and collect the roll of material from the freezer. I will complete the freezer log with the date and time of removal. I will leave the roll to defrost in the clean area and set up my workstation. I will check the workstation is clean before rolling out the pre-preg material. Using the drawings, I will use a felt pen and ruler to measure and mark out the dimensions of the sections needed to make up the plies. I will cut out the plies with scissors and mark the orientation of plies on the backing film. I will measure and mark out for the core using the foam material, cutting this to size with a sharp utility knife. The angles will be cut as per the drawings to make the core component. The core and plies will be set aside for the laying up and consolidation process.
6. I will lay the first ply onto the prepared mould surface making sure this is flat. I will apply the other plies in order onto the mould. The core will be placed on the upper sheet, these will be placed square. When all plies have been added, they will be consolidated using a moulding tool and de-bulked accordingly. I will apply a layer of wrinkled release film on top of the final ply. Peel ply is applied to the mould ensuring a good adhesion to the mould. Breather fabric is cut to size and placed on the moulding to make an air passage out of the moulding. The lower portion of a vacuum breach unit (VBU) is placed on top of the breather fabric. The material for the vacuum bag is cut to size and draped over the mould. The vacuum bag is constructed. A hole is made for the upper portion of the VBU and this is placed on top of the bagging material. A vacuum is applied to the VBU to consolidate the laminate. I will check for any leaks and rectify any found. I will check the wrinkles in the bagging material are evenly spaced around the moulding. I will perform a drop test to check for any loss of vacuum.

7. I will refer to the manufacturer's information to obtain the curing information for the resin material and set the oven accordingly. The moulding is placed in the oven, careful not to touch the sides of the oven, placing centrally to ensure good air flow around the moulding. The moulding will be left to cure for the designated duration.
8. Once curing time has completed, the moulding will be left to cool. Once cool it will be inspected to check the performance of the vacuum bag and curing. The vacuum bag and consumables will be removed and discarded. The mould will be checked for evidence of good consolidation. I will use a scraper to gently lift one corner of the laminate to free it from the mould, then using a plastic wedge I will complete the demoulding. Once free I will check the "A" side. I will use an abrasion tool to remove the sharp edges of the spacer block and sand the edges to the required dimensions. On completion I will clean the dust from the work area and dispose of all waste.
9. I will carry out steps 5 to 7 again to assemble the spacer block assembly using the same laying up, consolidation and curing processes. Once cured the final assembly will be sanded to the required dimensions. This will be set aside for quality checking.
10. The completed spacer block assembly will quality checked. The assembly will be checked for any defects and the final dimensions will be recorded and checked to see if the component meets the requirements and tolerances.
11. I will write a report to present my findings from quality check to the supervisor and evaluate my work. The report will cover the finished sizes of the components and assembly, the quality checks undertaken, evaluation of the final purpose, defects found with reasons for their occurrence and preventions and give recommendations for improvements to the spacer block design or process.
12. Finally, I will participate in a handover meeting with the supervisor. The meeting will cover the process of manufacturing the spacer block assembly, the findings of the quality inspection report and to give an overview of the processes taken, any problems encountered and any suggestions to the design or process. I will present the finished assembly and report to the supervisor.

## Commentary

The candidate has referred to the given brief in order to plan the activities, however the analysis was brief. They have produced a basic method statement; it is clear and well-presented but lacks detail. This demonstrates a basic knowledge and understanding to analyse and interpret technical documentation to plan all the activities for the composites manufacturing processes needed to produce the spacer block assembly.

The method statement does set out the intended steps that the candidate will take during the manufacturing process which shows a basic understanding of planning for future tasks. However, they could further improve by providing more detailed justifications, demonstrating their understanding of the processes and procedures to be followed. For example, stating how they would handle any problems during the processes such as adherence to timings or within the availability of the resources or considerations of issues such as: thawing time, handling of cured and uncured resins as well as fibres and cured mouldings.

The candidate has not mentioned referring or working to any procedures or any regulatory requirements. They could have stated the processes and procedures for waste and the Waste Regulations and how they should be applied.

The response could have been developed further if the candidate had provided more detail from the brief and had given more detailed justifications for the steps within the process and made reference to the types of technical documentation they would need to use for each process. For example, COSHH data sheets and manufacturer's information when working with the cleaning liquids and the material manufacturer's information for the curing recommendations specific to the material being used.

## 1. Quality check sheet

Feature	Criteria to be met	Met	Not met
Base dimensions	180mm X 80mm $\pm$ 0.5mm		
Thickness	2mm $\pm$ 0.4mm		
Core height	10mm $\pm$ 0.5mm		
"A" side	Flat and clear of FOD.		
Moulding	No evidence of bridging or surface wrinkling.		
Core	Not out of square with the base.		
All edges	Edges to be made safe, square and parallel.		
Final spacer block assembly	The spacer should be well presented, free from defects with dimensions meeting the specification and no evidence of FOD or fibre orientation misalignment.		

## Task 2a – Preparing the mould

(Assessment themes: Health and safety, Planning and preparation, Production (moulding, tools and equipment)).

For task 2a candidates need to produce the following piece of evidence:

- prepared mould.

For task 2a, assessors will need to produce the following pieces of supporting evidence:

- assessor observation incorporating:
  - mould preparation
  - preparation of materials
  - the prepared work area, during the task and the work area on completion of the task.

### Photographic evidence required:

- photographic evidence showing the prepared work area and on completion of the task - *Illustrated in task 2 photographic evidence section below (photographs 1 - 2) \**  
**\*Note: to avoid duplication, the assessor only needs to provide photographic evidence of work area set up and reinstatement once to show the candidate has met the criteria.**
- photographic evidence showing mould preparation - *Illustrated in task 2 photographic evidence section below (photograph 3 - 5)*
- photographic evidence showing preparation of materials - *Illustrated in task 2 photographic evidence section below (photographs 6 - 7)*

Photographs in this GSEM demonstrate the full process that the candidate has undertaken to complete the spacer block assembly. Commentary sections detail where performance is considered to be at a level reflective of a threshold competence grade. Note, due to the nature of this process, not all individual work activities would provide opportunity to demonstrate a defined level of differentiation beyond a pass – but these images are shown in order to show the cohesiveness of the process being undertaken, and to draw out where differentiation is possible.

## 2a. Photographic evidence – Preparation

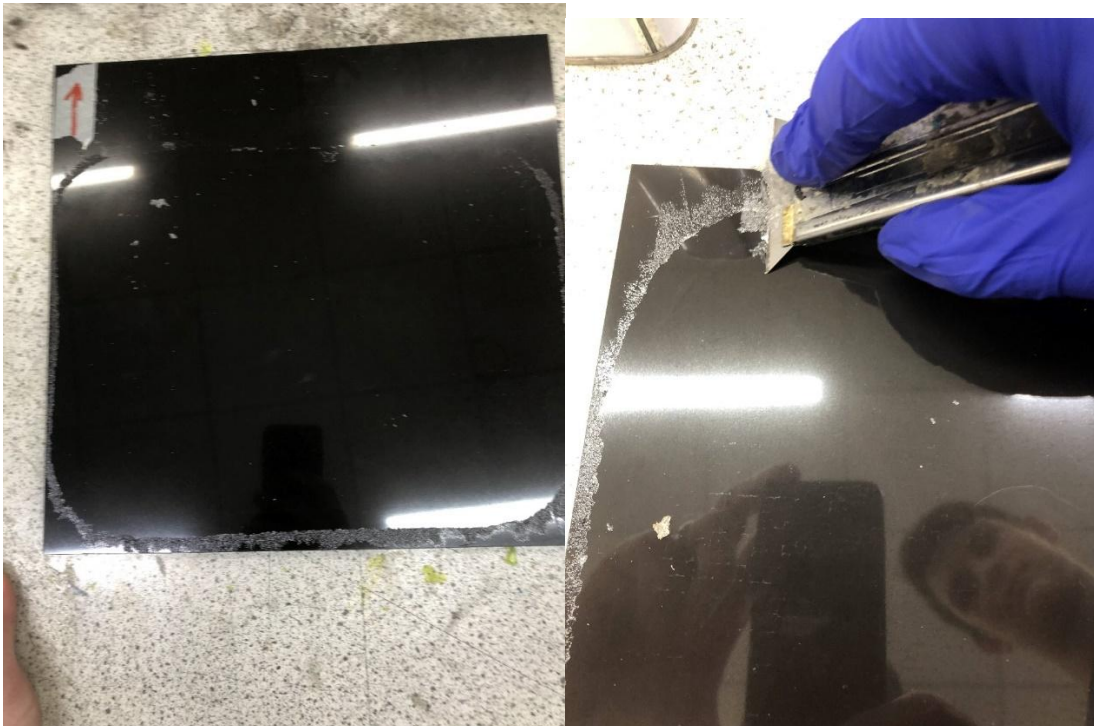
### Work area (photographs 1 – 2)

Photographs 1 and 2 – showing the prepared work area cleaned and the resources selected. The resources selected should be for the first task only to prevent overcrowding the workstation. Note: No additional PPE has been selected (gloves, mask).



### Mould preparation (photographs 3 – 5)

Photographs 3 and 4 – showing mould prior to preparation and cleaning. Residue from previous moulding activities is present and needs to be removed without damage to the mould occurring. Candidate is seen using a scraper to remove the residue.



**Photograph 5** – showing a prepared mould but with some residue still showing on outer edge. The residue left on the mould will create adhesion issues during the creation of the vacuum bag. The candidate should remove all residue to prevent this from arising later in the consolidation process.



#### **Preparation of materials (photographs 6 – 7)**

Photograph 6 – showing candidate wearing suitable PPE which has been checked for integrity. The candidate is safe but did not put the hood up and apply the zip cover to prevent FOD occurring within the production of the spacer block components and assembly which is required when simulating a clean room environment.



Photograph 7– showing composite material removal from storage (freezer). The material is kept in its bag and allowed to thaw for a period of time at room temp, before being unwrapped and rolled out to cut to size.



## 2a. Practical observation form - Preparation

<b>Assessment ID</b>	<b>Qualification number</b>
8713-333	8713-333
<b>Candidate name</b>	<b>Candidate number</b>
Candidate A	CG12345
<b>Centre name</b>	<b>Assessment theme</b>
City & Guilds	Planning and preparation, Health and safety, Production (moulding)

Complete the table below referring to the relevant marking grid, found in the assessment pack. Do not allocate marks at this stage.

<b>Task</b>	<b>Notes – detailed, accurate and differentiating notes which identify areas of strength and weakness are necessary to distinguish between different qualities of performance and to facilitate accurate allocation of marks once all evidence has been submitted.</b>
Work area preparation	The candidate put on their PPE and cleaned their workstation down, removing some sticky residue left by a previous job. The surfaces and floor areas were swept clean. A moulding tool had been left on bench by another user, this was visually checked and placed back in the store. All waste was disposed of in the general waste bin. Referring to their resources list, the candidate selected their equipment from the store. A porcelain ceramic tile was selected as the mould. Suitability checks were briefly completed.
Mould preparation	They selected a scraper to clean the mould. First removing the resin residue left over from previous use, then cleaned the mould using a proprietary mould cleaning product selected from the COSHH cupboard. The manufacturer's information was checked for the specified drying time. They applied the product using a direction designated in their method statement, allowed it to dry before repeating the cleaning process in the perpendicular direction. The mould surface was treated with a preparatory release agent. The candidate did not fully check that the cleaned mould was free from defects or was of acceptable flatness. Some old resin remained on the edge of the mould. The prepared mould was set aside in a clean area for later use. The workstation was cleaned and prepared creating a 'clean room' for the next stage.
Materials	The candidate needed to be reminded to re-apply their PPE zip cover and put up their hood of their overalls having removed their hood whilst outside of the workshop. The candidate checked their brief to confirm the type of resin and fibre system. They selected the correct material roll from the freezer, checking the roll was in-date, recording the date and time of the removal from the freezer on the inventory. The roll was put aside in a clean area to thaw to room temperature.

<b>Task</b>	<b>Notes</b> – <i>detailed, accurate and differentiating notes which identify areas of strength and weakness are necessary to distinguish between different qualities of performance and to facilitate accurate allocation of marks once all evidence has been submitted.</i>	
	Tools were given a visual check and a light clean before returning to storage. Cleaning product and release agent returned to COSHH cupboard. All health and safety procedures were adhered to, the risk assessment and method statement were referred to. PPE worn at all times with one reminder given.	
<b>Assessor signature</b>		<b>Date</b>
<b>Assessor A</b>		<b>16.12.2022</b>

## Commentary

The observation evidence has captured that the candidate demonstrated an acceptable understanding of how to prepare a work area for working with composites. For example, cleaning the work area to remove all dirt and debris to create a 'clean room' environment to prevent debris being introduced to the manufacturing process which could cause defects in the completed artefact.

The candidate has demonstrated a basic awareness of health and safety, for example, clearing excess waste away from the work area. The candidate could access higher marks by paying closer attention to detail regarding safety, for example, by paying more attention to health and safety information regarding the use of chemicals and by ensuring they wear the appropriate PPE in the workshop at all times. For example, the candidate was reminded to replace the hood of their overalls, which they had removed whilst outside of the workshop before they handled the composite material.

The candidate has demonstrated a basic knowledge and understanding of the mould preparation process and the need to carry out preparatory checks to check the mould prior to and after cleaning to ensure the mould does not detract from the quality of the end artefact. This could be improved to gain additional marks, for example the candidate carried out only basic checks before and after cleaning and did not check the cleaned mould for flatness.

## **Task 2b – Production of the spacer block components**

**(Assessment themes: Health and safety, Production (moulding, laminating, consolidation, curing and demoulding, tools and equipment).**

For task 2b candidates need to produce the following pieces of evidence:

- completed spacer block components.

For task 2b, assessors will need to produce the following pieces of supporting evidence:

- assessor observation:
  - the production of the spacer block components to include
    - the handling and application of composite materials
    - the application and use of tools and equipment
    - work area during and on completion of the tasks
  - the finished (demoulded and cured) spacer block components.

### **Photographic evidence required:**

- photographic evidence showing marking out and cutting materials - *Illustrated in task 2b photographic evidence section below (photographs 8 - 10)*
- photographic evidence showing the laying up process - *Illustrated in task 2 photographic evidence section below (photographs 11 - 18)*
- photographic evidence of the curing process - *Illustrated in task 2 photographic evidence section below (photographs 19 - 21)*
- photographic evidence of demoulding process – *Illustrated in task 2 photographic evidence section below (photographs 22 - 26)*
- photographic evidence of the finished (demoulded and cured) spacer block components – *Illustrated in task 2 photographic evidence section below (photographs 27 - 30).*

**For the purpose of this GSEM additional photographs have been included, however it is not expected that Providers will capture this level of evidence for each candidate. A sample is recommended to show the key points within a process and to highlight any defects or issues encountered etc.**

## 2b. Photographic evidence – Production of the spacer block components

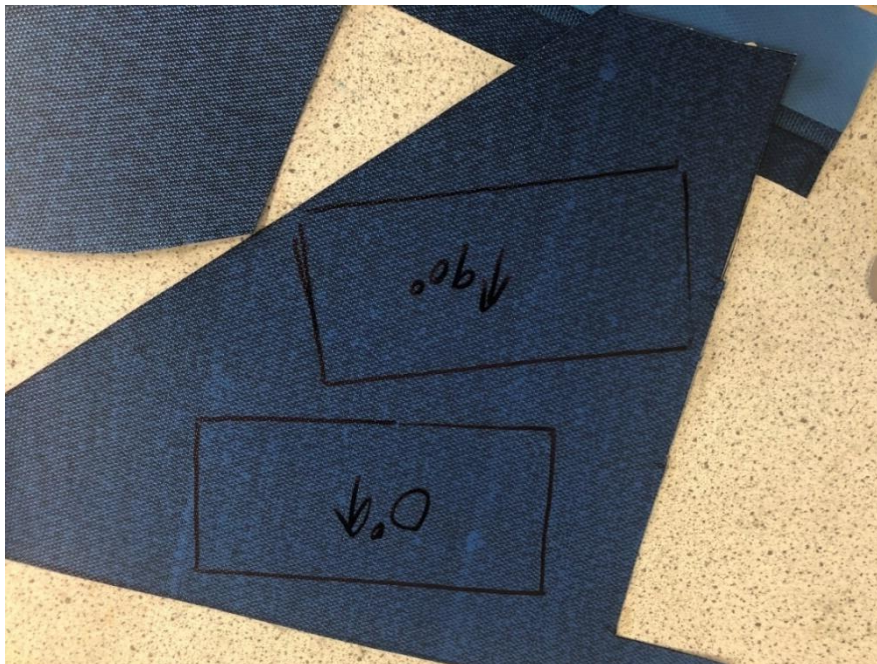
### Marking out and cutting materials (photographs 8 – 10)

Photograph 8 – showing the material unrolled, being marked out before being cut to usable size. Note: At this point the remaining pre-preg material would be returned to the freezer.

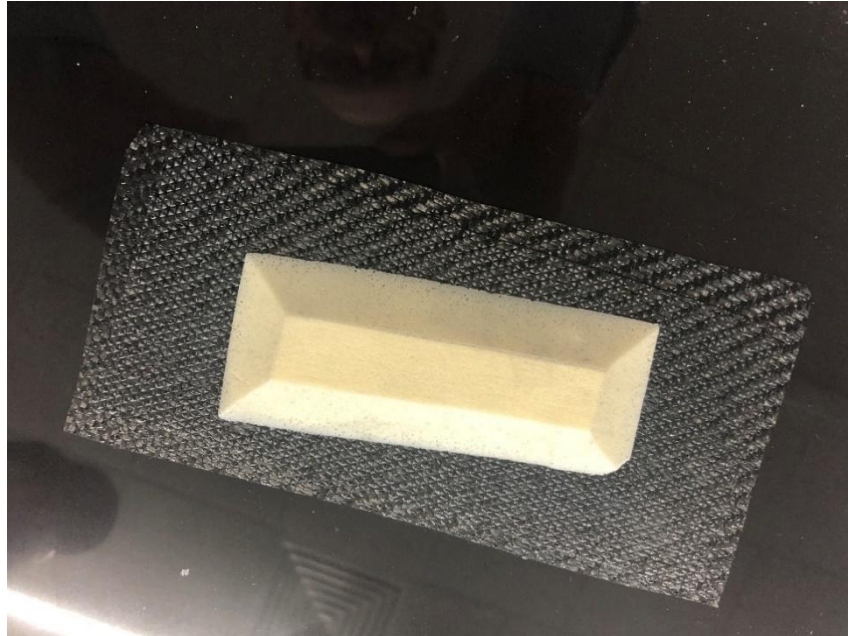


Photograph 9 – showing the material marked out ready for cutting. Orientation of plies is identified and marked on the backing film. Material to be cut-out to form the “kit” of parts using scissors.

Note: some poor marking out and wastage of material as it is some way from the edge of the sheet and the positioning of the marked out plies should be closer together and not angled.

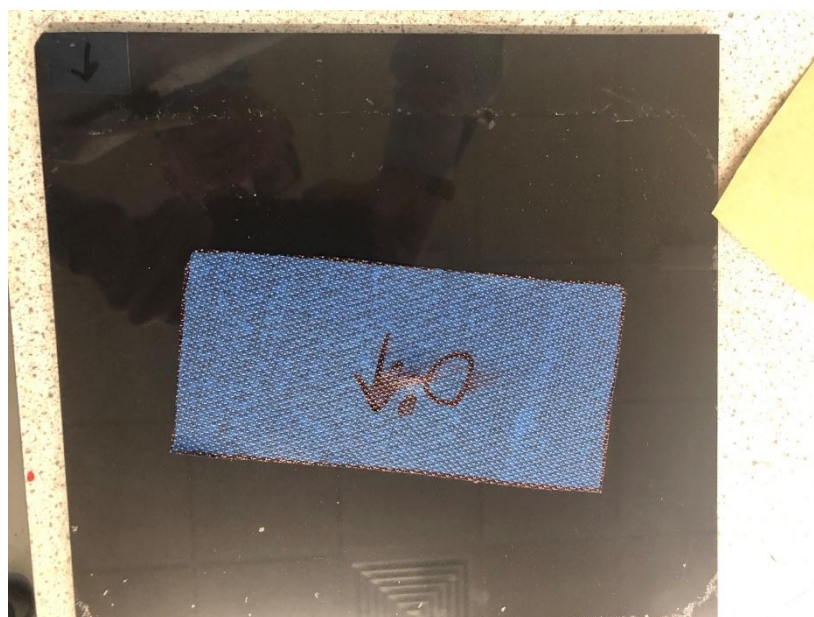


Photograph 10 – showing the core material cut to near shape ready for final reduction to dimensions. Note: Poor cutting of the foam material, there is some damage to the core edges, the dimensions are not square and the angles are not as per specification. One corner is rounded.

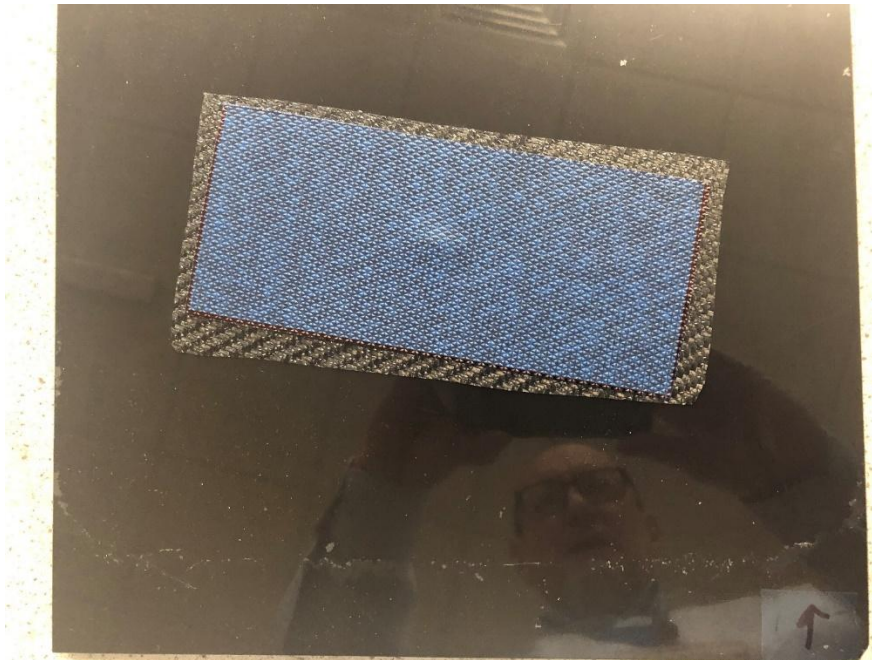


#### Laying up process (photographs 11 – 18)

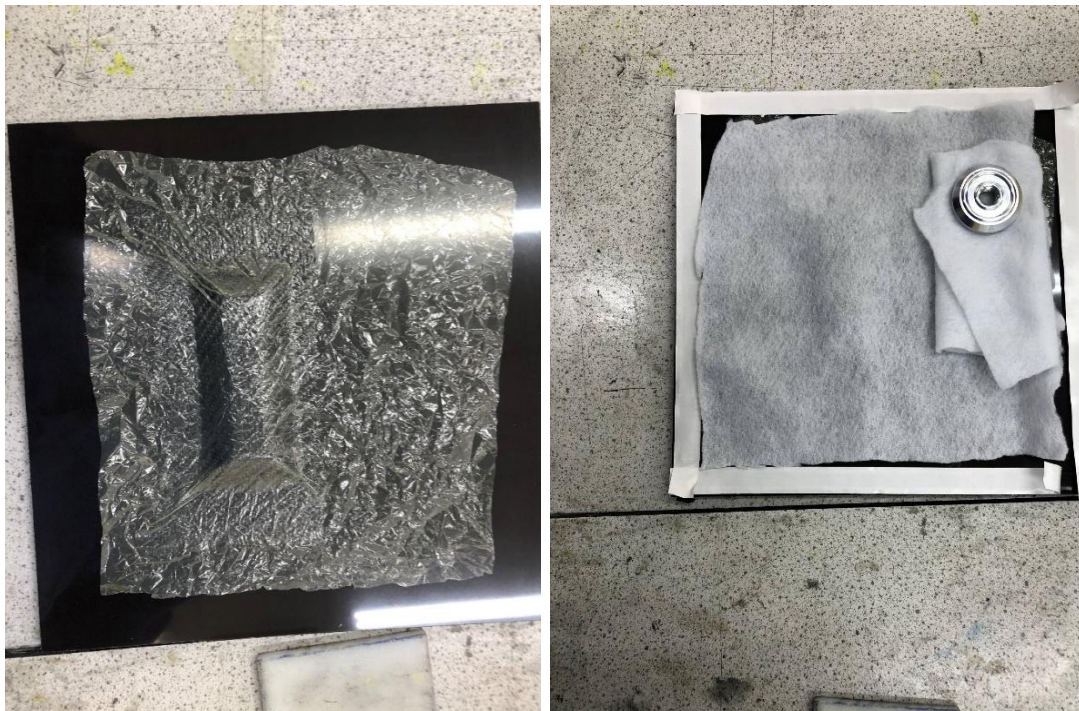
Photograph 11 – showing the first ply laid onto the prepared mould surface. Some waviness of cutting of materials and blemishes on the mould surface.



Photograph 12 - showing subsequent plies laid up onto the mould and the core placed on the upper sheet. Some evidence of "out-of-square" and disruption of the warp and weft pattern.



Photographs 13 and 14 - showing the upper plies applied and consolidated using a moulding tool. De-bulk applied according to method statement. Release film has been wrinkled and placed on top of the final ply. Peel ply applied on top of the release film with additional breather fabric cut to make an air passage out of the moulding. VBU lower portion placed on top of breather fabric but on the moulding. Some issues with adherence to the mould surface.



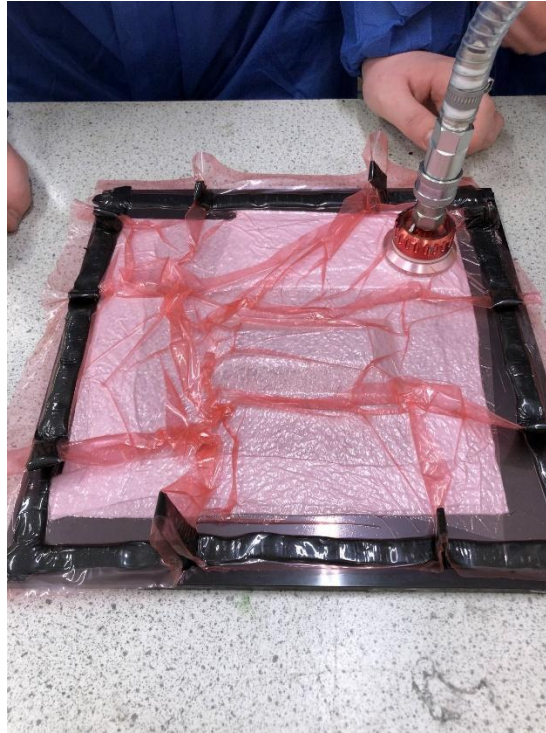
Photograph 15 - showing one corner sealed and the adjacent corner is stuck down leaving (in this case, too much material) slack to allow the bag to drape across the laminate.



Photographs 16 - showing the first pleat created to create the vacuum tight seal to ensure good application of consolidation pressure. Some issues with the adhesion of the film to the mould.



Photograph 17 – showing the vacuum bag is airtight. A hole has been created for the VBU and placed on top of the vacuum bagging material. With vacuum applied to the VBU to consolidate the laminate. Candidate checking for, and rectifying any leaks, to ensure the wrinkles are spaced equally around the moulding. Some leaks were present and were eventually remedied.



Photograph 18 – showing a drop test has been performed with a loss of vacuum, no less than specified in the method statement. Some remedials required.



## Curing process (photographs 19 – 21)

Photographs 19 and 20 - showing the preparation of the oven for the curing cycle. Manufacturer's information obtained to set the oven for the required temperature and duration.

CURING

XPREG® XC110 is designed to be oven cured in a vacuum bag at full vacuum pressure however it can also be cured in an autoclave or hot-press. Minimum vacuum pressure is 10mbar.

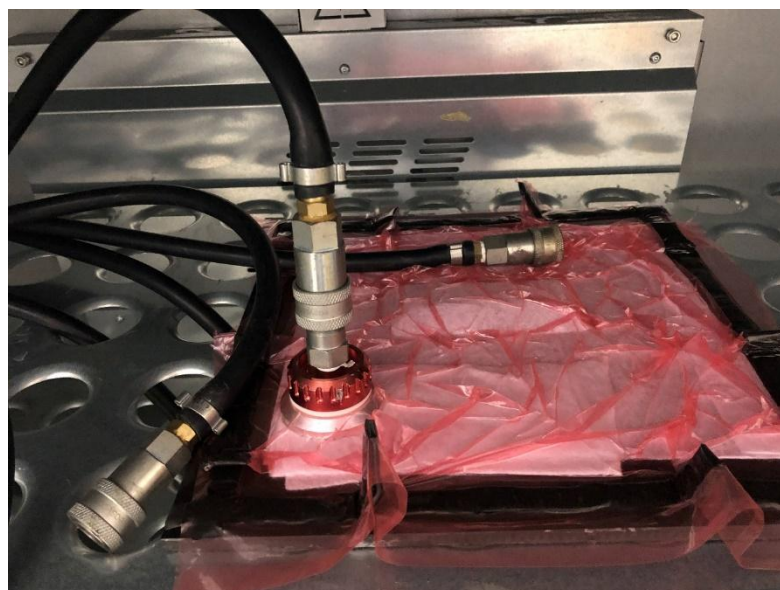
For best results, an accurately controlled multi-stage temperature cycle with final cure temperature of 120°C should be followed:

**STANDARD CURE CYCLE**

Step	Start Temp	Ramp Rate	Duration	End Temp	Elapsed Time
1	~ 20°C	1°C /min	00:50	70°C	00:50
2	70°C	Soak	04:00	70°C	04:50
3	70°C	2°C /min	00:25	120°C	05:15
4	120°C	Soak	01:00	120°C	06:15
5	120°C	Natural Cool	--	~20°C	07:15

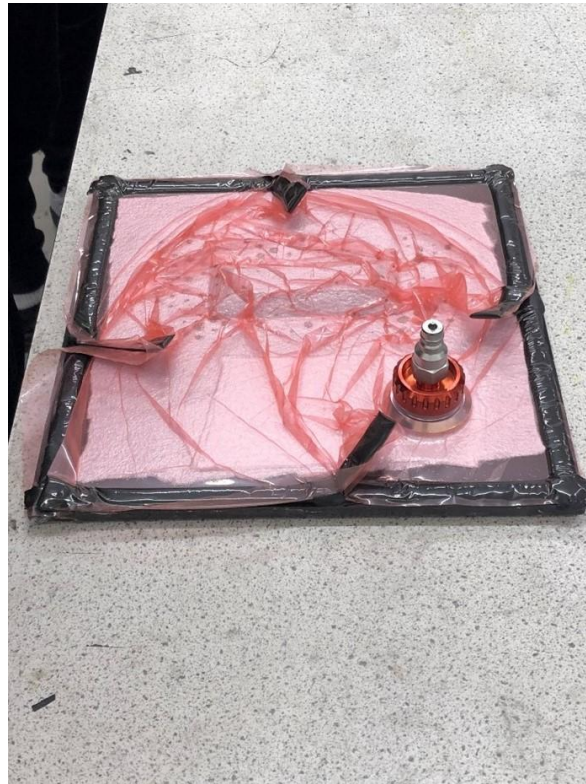
For detailed information, including alternative cure cycles from 85°C see the XC110 Processing Handbook.

Photograph 21 - showing the mould placed in the oven, not touching the sides, with the vacuum applied to the VBU in the oven. A vacuum hose has been left draped across the mould which is not best practice.



### Demoulding and finishing process (photographs 22 – 29)

Photograph 22 – showing the mould removed from oven after curing and allowed to cool. Wrinkles are present across the mould surface.



Photograph 23 - showing bagging film being removed to reveal the release film. Evidence of good consolidation and curing. Some wrinkling of release film but the surface of the moulding is acceptable. Some resin bleed identified.



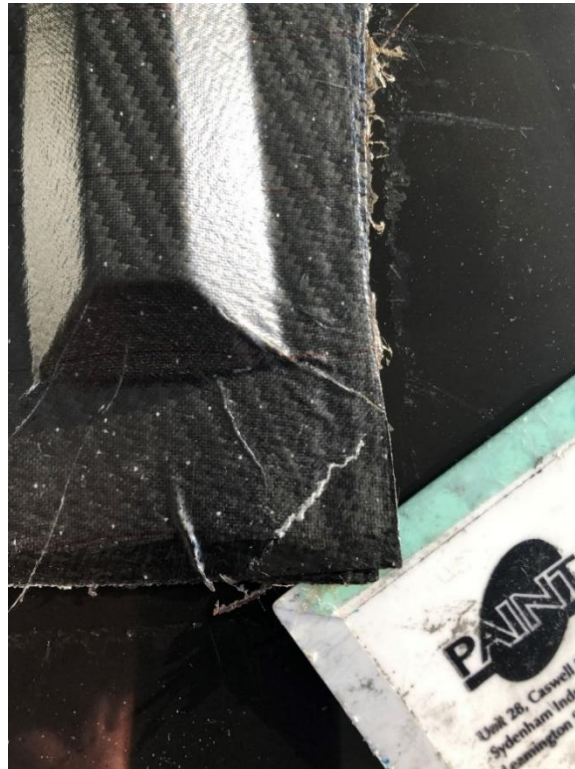
Photograph 24 – showing detail of edges, corners and transitions showing inconsistent definition and orientation of fibre.



Photographs 25 and 26 – showing a scraper being used to lift one corner at the beginning of the demoulding, followed by a plastic wedge to complete the process of demoulding, ensuring that the lift is not too abrupt to overstress or crack the laminate.



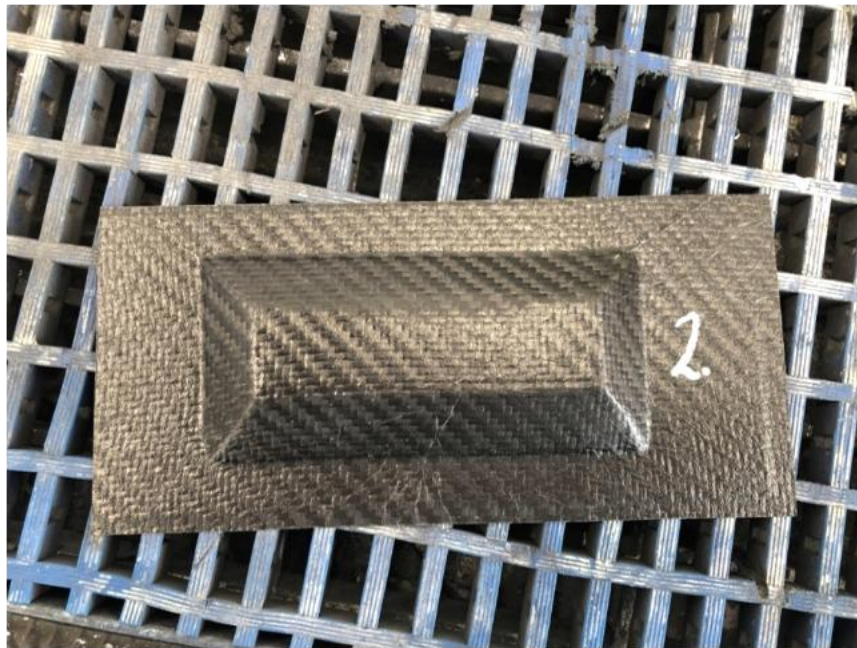
Photograph 27 – showing the lower corner has been cracked because of poor mould preparation and inserting a wedge that was too large. Some evidence of surface imperfections caused by the wrinkling of the moulding consumables.



Photograph 28 – showing candidate performing measurement checks to ensure dimensions meet specification prior to safe edging. Correct tools were utilised however calibration checks were not thorough.



Photograph 29 – showing finished component safe edged prior to final dimensioning. The photo depicts some non-conformities and issues with squareness and dimensions of the core, surface imperfections resulting from the peel-plies and consumables.



Photograph 30 – showing the reinstated work area. Note: The surfaces have been cleaned but not all waste has been disposed of.



## 2b. Practical observation form – Producing the spacer block components

<b>Assessment ID</b>	<b>Qualification number</b>
8713-333	8713-333
<b>Candidate name</b>	<b>Candidate number</b>
Candidate A	CG12345
<b>Centre name</b>	<b>Assessment theme</b>
City & Guilds	Production (Laminating, Consolidation, curing and demoulding, Tools and equipment, Health and safety)

Complete the table below referring to the relevant marking grid, found in the assessment pack. Do not allocate marks at this stage.

<b>Task</b>	<b>Notes – detailed, accurate and differentiating notes which identify areas of strength and weakness are necessary to distinguish between different qualities of performance and to facilitate accurate allocation of marks once all evidence has been submitted.</b>
Measuring, marking out and cutting	Work area prepared as previous observation. PPE correctly worn. The candidate unrolled the material and marked out the material to usable size using a steel rule and a felt pen and cut using scissors. They briefly checked the drawings and marked out the individual components on the material. This was not thought out, poor marking out technique causing some excess wastage of material. They did not take account of the drape of the top layer. This could be improved. Orientation of plies was identified and marked on the backing film. The measurements were not always accurate. The components were cut out using shears and a knife. The accuracy of the cuts was poor at times. They did not immediately mark the cut material leading to some confusion when retrospectively labelling the layers with the correct orientation and ply number. This could have been avoided if they had checked their method statement. They marked out and cut to size the foam core material, chamfering the edges, some inaccuracies in marking out affected the angle. This could have been done better.
Laying up	The backing film was removed from the first layer of pre-preg material and applied to the mould. This was consolidated following the standard process. Some waviness of the cut materials. The lower laminate was then built up and de-bulked with reference back to the laminating plan in their method statement. The core was placed on peel ply creating a surface, for bonding on top of the prepared mould surface, this was out of alignment with the specified position.  The top laminates were then placed onto the core and mould. Some layers were out of square with some disruption of the warp and weft pattern. This could be

<b>Task</b>	<b>Notes</b> – <i>detailed, accurate and differentiating notes which identify areas of strength and weakness are necessary to distinguish between different qualities of performance and to facilitate accurate allocation of marks once all evidence has been submitted.</i>
Curing	<p>improved if they had referred more often to their laminating plan. They briefly checked for draping or wrinkling of the layers of composite material. They used a moulding tool to attempt a good consolidation but they over consolidated, crushing the core. They removed the backing film from the upper layer and added it accordingly. They did not fully undertake a count-back check to avoid FOD being left between the laminates. This may cause defects within the final product.</p> <p>A peel ply was cut to size and placed over the laminates as specified in the method statement. Release film was cut to size and placed on top of the peel ply and breather fabric was cut to near size and placed over the peel ply. They positioned the Vacuum Breach Unit (VBU). They cleaned the periphery (10mm approx.) to facilitate good adhesion of the vacuum bag. The vacuum bag was prepared, and a vacuum was applied. Some issues were encountered with achieving a good adhesion. This was remedied to achieve an adequate seal. They performed a drop test, the candidate needed to further adjust the bag to achieve the correct vacuum.</p> <p>The materials manufacturer’s recommendations for the curing temperatures and durations were checked. The oven was safely prepared, parameters were set but they did not complete a stepped process when heating the oven. Mould was placed into the oven, avoiding the sides of the oven. A stray hose was observed encroaching part of the mould. The mould was then left to cure.</p> <p>The work area reinstated, all waste removed and correctly disposed of. Correct PPE was worn throughout after the candidate was reminded to zip their overalls up fully prior to starting the lamination process.</p>
<b>Assessor signature</b>	<b>Date</b>
<b>Assessor A</b>	<b>17.12.2022</b>

## Commentary

The candidate evidence demonstrates a basic level of knowledge and understanding of the marking out, cutting, laying up, laminating, consolidation and curing processes. The candidate completed the processes in the correct order but the candidate did not perform all activities without encountering some problems.

The laminating process was followed with some reference back to their method statement. Materials were applied to the mould some of the time, correctly understanding the layering process but were not accurate when piling up the layers, with some layers seen to be out of square, see photograph 12 in the photographic evidence section. The plies were layered following a procedure, but the candidate did not fully understand the need to perform a count back to ensure the plies were placed according to their plan to avoid Foreign Object Debris (FOD) during the laying up and consolidation process.

The consolidation process was followed, the candidate attempted good consolidation but over consolidated the core by using too much pressure. This could weaken the strength of the final product. The candidate referred back to their consolidation plan within their method statement only some of the time. The candidate demonstrated some good practice with laying out the consumables on the moulding, carefully pre-wrinkling the release film allowing the material to cover the moulding. The candidate did encounter a problem when creating the vacuum, this was caused by poor adhesion of the peel ply to the mould surface, due to the old residue left on the mould. This could have been avoided if all residues had been removed during the cleaning process.

The candidate correctly referred to the manufacturer's data to obtain the information for curing and equipment set up. This could have been improved if the candidate had followed a stepped procedure when pre-heating the oven and by checking the position of the mould within the oven. For example, removing excess hoses or to check hoses were not encroaching on the mould, see photograph 21. This could affect the distribution of heat during the curing, resulting in some unevenness in the curing.

The candidate demonstrated a basic understanding and awareness of the need to maintain accuracy, for example the marking out and cutting of the components from the material was not carefully done to maintain the dimensions and created excess waste material. For example, the candidate had not considered the drape of the top layer and the edge of the material, see photograph 9.

The candidate demonstrated an acceptable knowledge and understanding of referring to technical documentation throughout the manufacturing process, for example, referring to their method statement and manufacturer's information for curing the material.

The candidate could have developed their response further if they had demonstrated a more comprehensive understanding of the processes they were undertaking and understanding of how the processes interact with each other. For example, the accuracy of the measurements and cut components will affect the laying up of the laminate and maintaining squareness and how not preparing the mould thoroughly at the beginning affects the consolidation process. Additionally, further development would have been seen if the candidate had made more reference to their plans for both laminating and consolidation.

## 2b. Practical observation form - Demoulding

<b>Assessment ID</b>	<b>Qualification number</b>
8713-333	8713-333
<b>Candidate name</b>	<b>Candidate number</b>
Candidate A	CG12345
<b>Centre name</b>	<b>Assessment theme</b>
City & Guilds	Production (curing and demoulding, tools and equipment), Health and safety)

Complete the table below referring to the relevant marking grid, found in the assessment pack. Do not allocate marks at this stage.

<b>Task</b>	<b>Notes – detailed, accurate and differentiating notes which identify areas of strength and weakness are necessary to distinguish between different qualities of performance and to facilitate accurate allocation of marks once all evidence has been submitted.</b>
Demoulding	<p>The candidate put on their PPE and prepared their work area. They correctly checked the mould was cool and suitable to handle. They completed a quick check for signs of vacuum depletion. Some wrinkles present across the mould surface. Bagging film removed and disposed of accordingly. Some good consolidation and curing achieved but not consistent, some wrinkling of the release film but this is acceptable. Some resin bleed identified.</p> <p>They correctly selected demoulding tools (knife and a plastic lifting tool). They correctly started at one corner, cautiously lifting the laminate, then used the lifting tool to ease the rest of the laminate away from the mould. The demoulding was not abrupt but the candidate used too much pressure with the lifting tool, causing one corner to crack. A thinner lifting tool may have prevented this. The demoulded laminate was briefly inspected, some resin leakage was present on the mould. This is normal. The crack on one corner of the laminate was observed. The candidate safe edged the cured laminate with an abrasive sanding block removing the sharp edges. The “A” side was briefly checked for evidence of FOD.</p>
Finishing	All spacer block components were abraded to near size; this was not performed accurately as one side was over abraded. Measurements were taken to then continue to abrade the laminate to size as per the specification ready for assembly.
Health and safety	The work area was reinstated. All dust was swept up and disposed of correctly, minimising the spread of the dust. Tools were briefly cleaned and returned to storage; the condition was not checked.
<b>Assessor signature</b>	<b>Date</b>
Assessor A	17.12.2022

## Commentary

The observation evidence provided shows the candidate has an overall basic knowledge and understanding of the demoulding process.

The result of the consolidation and curing was acceptable however this could be improved. For example, there was some wrinkling observed across the top of the mould which could leave some marks on the top layer. If the candidate had adjusted the vacuum bag before curing and removed or better distributed the creases this could have been avoided.

The candidate's lower level of understanding of the material properties is demonstrated by their approach to demoulding the cured laminate. They followed the correct procedure to remove the laminate from the mould, using the correct tools for the job and for the type of mould used but the excess pressure applied to the lifting tool caused the corner of the material to crack, see photograph 27.

The candidate followed the appropriate health and safety procedure demonstrating an acceptable knowledge and understanding of adhering to health and safety, for example, ensuring all dust was cleared away and disposed of correctly as not to cause a hazard. The candidate could have improved further by thoroughly cleaning the tools before returning to storage to remove any traces of dust or debris which could harm another user if left on the tools.

The candidate could have developed their response further if they had a better understanding of the need for accuracy and by performing more in-production measurement checks; excess material removal is avoided. For example, the candidate over abraded one side of the moulding resulting in too much material being removed. Additionally further development could have been seen if they had checked the creasing on the vacuum bag prior to curing to avoid any marks left by the wrinkles to the surface.

## Task 2c – Assembly

**(Assessment themes: Health and safety, Planning and preparation, Production (laminating, consolidation, curing and demoulding, assembly, tools and equipment)).**

For task 2c candidates need to produce the following pieces of evidence:

- the completed spacer block assembly.

For task 2c, assessors will need to produce the following pieces of supporting evidence:

- assessor observation:
  - the stages of the assembly of the spacer block
  - the completed spacer block assembly
  - the handling and application of composite materials
  - the application and use of tools and equipment
  - work area during and on completion of the tasks.

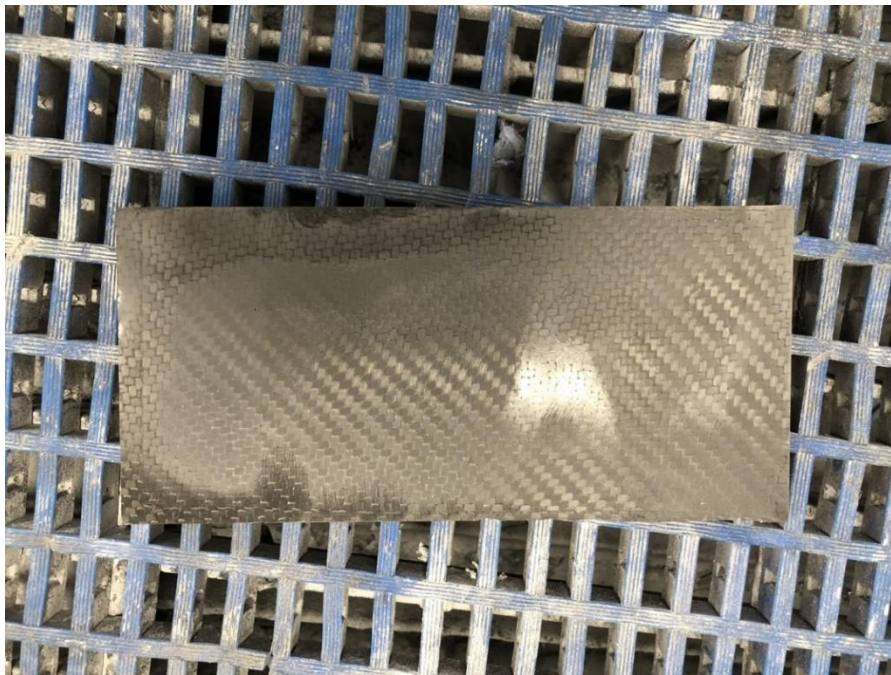
### **Photographic evidence required:**

- photographic evidence of assembly process of the spacer block (incorporating evidence of bonding, curing, trimming and finishing) - *Illustrated in task 2 photographic evidence section below (photographs 31 - 40)*
- photographic evidence of the completed spacer block assembly - *Illustrated in task 2 photographic evidence section below (photograph 41).*

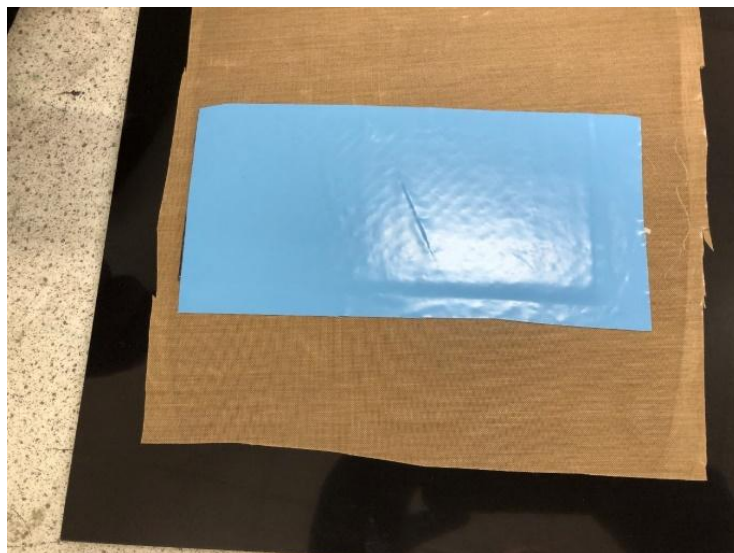
## 2c. Photographic evidence – Assembly

### Assembling the spacer block (photographs 31 – 40)

Photograph 31 – showing the underside of the spacer block on completion of being abraded. Abrasion of the lower surface showing signs of inconsistent application of abrasive medium and a lack of consistent colouration and texture.



Photographs 32 – showing the film adhesive placed onto the second ply and consolidated with the backing film still applied.



Photograph 33 – showing the backing film removed from the adhesive film and cut to size to ensure minimum bleed out.



Photograph 34 – showing the spacer block component placed on top of release film. Note bottom left corner has no adhesive film overlap. The film should melt into this area during curing, but it is not good practice. Bottom edge showing some signs of inconsistent trimming activities.



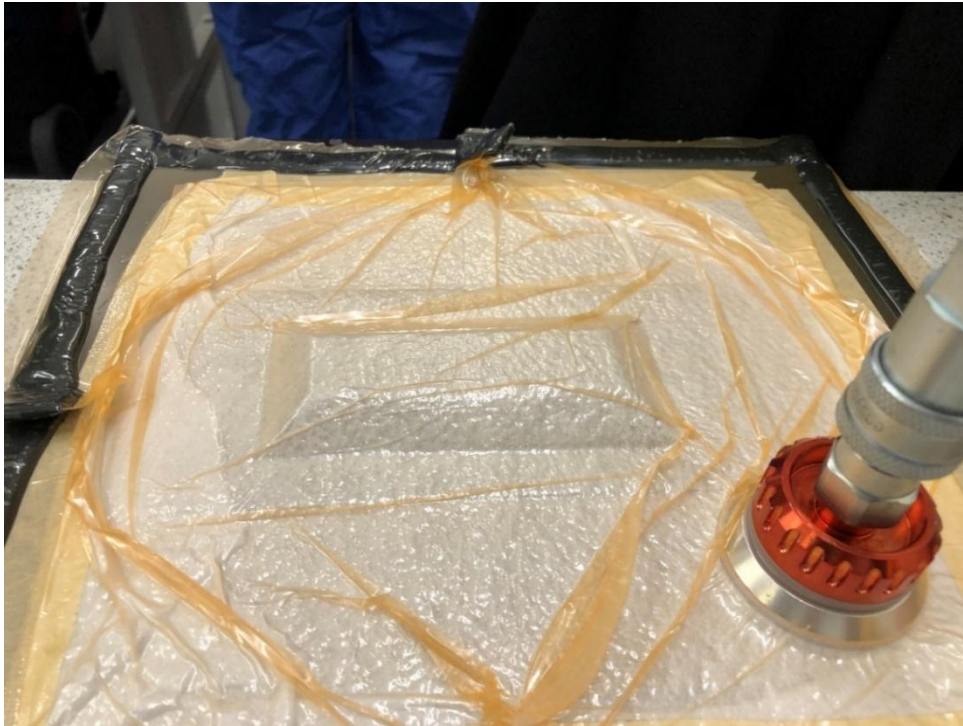
Photograph 35 – showing release film placed on top of the moulding. Note: wrinkled to aid draping.



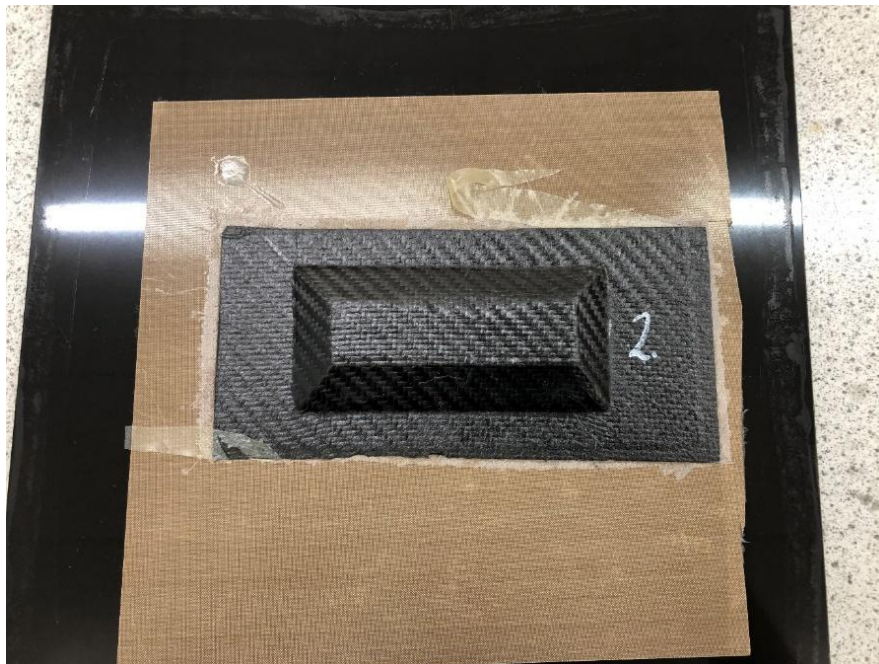
Photographs 36 and 37 – showing breather fabric placed onto moulding and taped down with VBU being trial placed to ensure no interference with the moulding. Vacuum bag created. Pleats allowing for effective consolidation. Vacuum applied.



Photograph 38 - showing full consolidation pressure applied and wrinkles or pleats spaced out ready for curing in the curing oven. Some are still left across the surface which should be removed for best practice, but it should be remembered that the upper half is already cured.



Photograph 39 – showing result of the curing. Assembly sitting on top of PTFE release layer. Evidence of complete bonding as a result of resin bleeding out evenly from the upper and lower sections.



Photograph 40 – showing the checking of “A” side for defects or FOD. Some inclusions present.



Photograph 41 - showing the final assembly which has been safe edged and ready for machining to final dimensions. Note the cracking of the bottom left corner and the presence of FOD embedded in the laminate that was present as a result of not cleaning the mould sufficiently.



## 2c. Practical observation form – Assembly of the spacer block

<b>Assessment ID</b>	<b>Qualification number</b>
8713-333	8713-333
<b>Candidate name</b>	<b>Candidate number</b>
Candidate A	CG12345
<b>Centre name</b>	<b>Assessment theme</b>
City & Guilds	Production (assembly, tools and equipment), Health and safety.

Complete the table below referring to the relevant marking grid, found in the assessment pack. Do not allocate marks at this stage.

<b>Task</b>	<b>Notes – detailed, accurate and differentiating notes which identify areas of strength and weakness are necessary to distinguish between different qualities of performance and to facilitate accurate allocation of marks once all evidence has been submitted.</b>
Assembly	<p>The candidate put on their PPE and prepared their work area. They created a clean area for the assembly.</p> <p>A dry test fit of the upper and lower sections was performed to check the overlap and orientation. Some inaccuracies with the fit and the candidate rectified these. They checked their method statement for the bonding process, checking the orientation and consolidation needed to permanently bond the upper and lower sections. The components were adequately prepared. Some areas were unevenly abraded. They proceeded to bond the upper and lower laminates using a peel ply. Adhesive film was not trimmed evenly. Consolidation was applied according to their plan in their method statement. Consolidation and curing was carried out better this time, pleats were placed better, and hoses were correctly placed in oven, no interference with the moulding. The candidate checked the curing times in the manufacturer’s information.</p> <p>The cured moulding was briefly inspected for signs of debonding or non-conformities. Some areas were identified as not being equally bonded. The “A” side showed some warping on the underside. Some FOD (dust particles) contained within the laminate. All edges were checked, some excess bonding agent was removed. The moulding was abraded to dimensions according to the drawings, but the candidate did not check the accuracy of the final dimensions.</p> <p>The work area was reinstated, tools returned to storage. The candidate did not remember to wipe down the workbench after abrading the spacer block to finished dimensions, leaving some dust on the bench.</p>
<b>Assessor signature</b>	<b>Date</b>
Assessor A	18.12.2022

## Commentary

The observation report captures that the candidate has followed an adequate assembly process to produce the final spacer block.

The candidate has shown a basic understanding of the bonding processes needed and the consolidation and curing needed to complete the assembly, for example, they correctly performed a dry fit of the components prior to starting the bonding procedure. This enabled them to make some minor adjustments to ensure the correct fit prior to bonding. This was due to some inaccuracies that occurred in the manufacturing process of the components, namely the inaccuracies in cutting and laying up squareness. A compatible bonding agent was used however the candidate did not trim the adhesive film accurately resulting in an uneven resin bleed between the upper and lower layers, this resulting in some areas of poor uneven bonding.

The consolidation process could have been improved. For example, if the candidate had abraded each component equally, by achieving a consistent colouring and texture to the surface, enabling the bonding agent to adhere more evenly and creating a stronger bond when fully cured. See photograph 31.

The candidate could have developed their response if they had demonstrated more accuracy when applying and trimming the adhesive film to achieve a better quality consolidation of the final assembly, with minimal areas of lifting and some loss of rigidity.

The response could further have been developed if the candidate had demonstrated a higher level of cleanliness throughout. This would have prevented the foreign object debris (FOD) from being trapped during the manufacturing process and causing the visual defects in the spacer block, see photograph 40. In addition, the candidate could have demonstrated cleanliness through cleaning their tools and workstation more thoroughly.

## **Task 3a – Defect identification**

**(Assessment themes: Health and Safety, Quality review and evaluation  
(Assembly and quality control, reporting, recording and handover)**

For task 3a candidates need to produce the following piece of evidence:

- list of identified defects with cause and prevention indicated.

For task 3a, assessors will need to produce the following pieces of supporting evidence:

- assessor observation:
  - defect identification process.

Photographic evidence

- the defect identification process being undertaken.

The following task 3a, assessor evidence has not been included for this version of the GSEM:

Photographic evidence

- the defect identification process being undertaken.

## Candidate evidence

### 3a. Defect identification

Name: Candidate A		
Defect	Cause	Prevention
Dimensions not met.	Inaccurate marking out and cutting of materials. Not considered drape and fitting of material over the core.	Make sure the material is cut to shape to meet the size requirements of the finished artefact. A test fit should be carried out to check it all fits together.
Bridging of material over the core.	Care not being taken to ensure that the plies are properly applied onto each other. Not using correct consolidation pressure during the de-bulk or curing. Not producing sufficient pleats in the vacuum bag to ensure corners and transitions can have correct consolidation pressure.	Better use of moulding tools to get the plies pressed into the corners. Make sure the vacuum bag is able to apply consolidation pressure to the flat areas of the moulding. The vacuum bag needs to have enough pleats and slack to allow even consolidation pressure.
Tear-out of the "A" side.	Release agent not being properly applied to the mould causing the matrix to stick to the mould. When the moulding is removed, it leaves matrix material on the mould and some damage to the moulding.	Make sure the release agent is properly applied to allow a good release and make sure more care is taken when removing the moulding.
Dry areas on the "A" side.	Matrix material has been depleted from areas of the "A" side as result of breather fabric coming into contact with the uncured moulding.	Make sure the breather fabric is separated from the moulding by release film.
Delamination of the laminate.	Foreign material (FOD) has been allowed to get into the laminates during the laminating process. Consolidation pressure has not been applied evenly to the moulding during de-bulk or curing.	Make sure adequate processes are followed during the laminating process and appropriate PPE and the area is clean to protect the material from FOD. The bag needs to be capable of holding vacuum for sufficient periods of time to make sure consolidation occurs.

## Commentary

The candidate has identified some of the defects in the given test sample that have arisen as result of the manufacturing process. They have attributed a cause and offered a prevention for all of the defects identified.

This demonstrates that the candidate has an understanding of defects and how they are caused. The processes to identify and rectify defects are briefly explained and some implications for prevention or repair are briefly offered. These could be improved by providing more detail, for example, by further explaining how the dry areas on the 'A' side could be prevented and where this fits within the manufacturing process.

The candidate missed two defects. The defects not identified were the crushed core and the poor dimensional accuracy with the squareness of the base and upper sections.

The candidate has recorded their findings in a table which is suitable for the task.

The candidate could have developed their response if they had found the other defects and provided more detailed responses for the defects they had identified.

### 3a. Practical observation form – Defect identification process

<b>Assessment ID</b>	<b>Qualification number</b>
8713-332	8713-332
<b>Candidate name</b>	<b>Candidate number</b>
Candidate A	CG12345
<b>Centre name</b>	<b>Assessment theme</b>
City & Guilds	Quality review and evaluation

Complete the table below referring to the relevant marking grid, found in the assessment pack. Do not allocate marks at this stage.

<b>Task</b>	<b>Notes</b> – <i>detailed, accurate and differentiating notes which identify areas of strength and weakness are necessary to distinguish between different qualities of performance and to facilitate accurate allocation of marks once all evidence has been submitted.</i>	
Defect identification process	<p>The candidate inspected the pre-fabricated composite assembly with some consideration of process to be followed. The candidate used basic visual observation techniques as a basis to identify defects with the assembly.</p> <p>The candidate's approach to inspection was somewhat haphazard, moving between different parts of the assembly. This allowed the candidate to identify most of the defects present, but not all. The candidate performed a ring test to check for areas of delamination, the candidate used a pen to carry out the test, this is not the standard procedure.</p> <p>Identified defects were recorded in a table. The candidate provided a cause and suggested preventative measures for each defect identified.</p>	
<b>Assessor signature</b>	<b>Date</b>	
Assessor A	19.12.2022	

## Commentary

The candidate has carried out a basic examination and inspection of the defective sample and has identified some of the defects within the defective sample. To develop their response, the candidate could have followed a more logical sequence and been more thorough when inspecting the defective sample in order to identify more of the defects present.

The candidate has provided some basic reasoning for the cause and a preventative measure for each defect identified.

The candidate has used appropriate equipment some of the time to carry out the inspection and testing of the sample, but in some instances more suitable equipment may have been used. For example, when performing the ring test, they used a pen rather than a tap hammer or coin which would have provided more accurate results than using the pen.

The results of the testing were recorded in a table which was clear and logical and suitable for the task.

## Task 3b – Quality review and recording

**(Assessment themes: Health and safety, Quality review and evaluation (quality review, reporting, recording and handover))**

For task 3b, candidates need to produce the following pieces of evidence:

- completed quality check sheet
- quality inspection report.

For task 3b, assessors will need to produce the following pieces of supporting evidence:

- assessor observation:
  - quality checking process
  - application of measuring equipment.

### **Photographic evidence required:**

- photographic evidence of the quality checking process being undertaken and the use of the quality check sheet – *Illustrated in task 3 photographic evidence section below (photographs 42 - 48).*

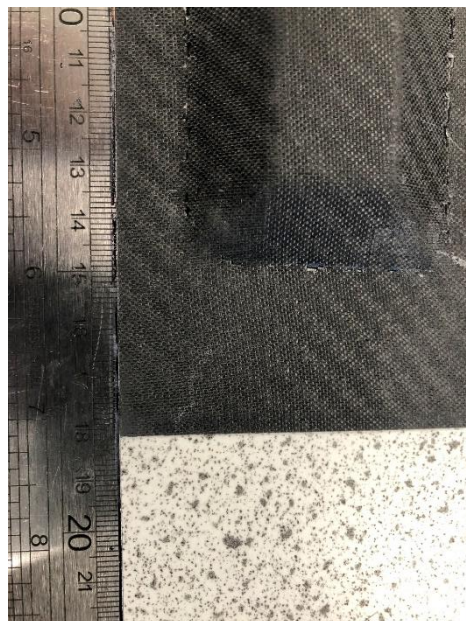
### 3b. Photographic evidence – Quality process

#### Quality checking process (photographs 42 – 48)

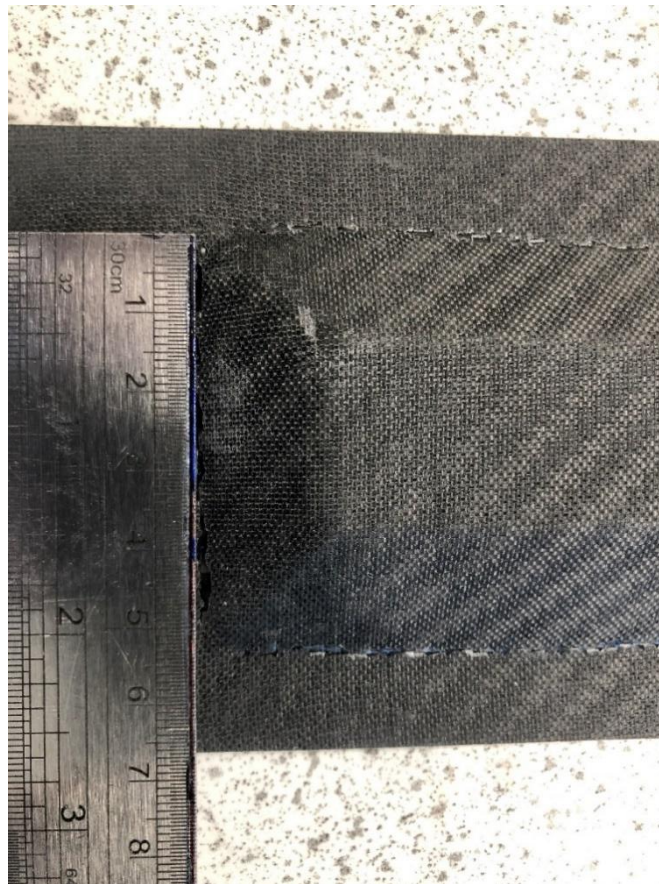
Photograph 42 – showing candidate checking the width of the assembly. Note: some run-out of the core in terms of not being parallel with the edge. Dimension not consistent with drawing.



Photograph 43 – showing dimensional check of length. Some more material removal required. Note poor definition of edge or core and evidence of poor consolidation over the core and in the transitions.



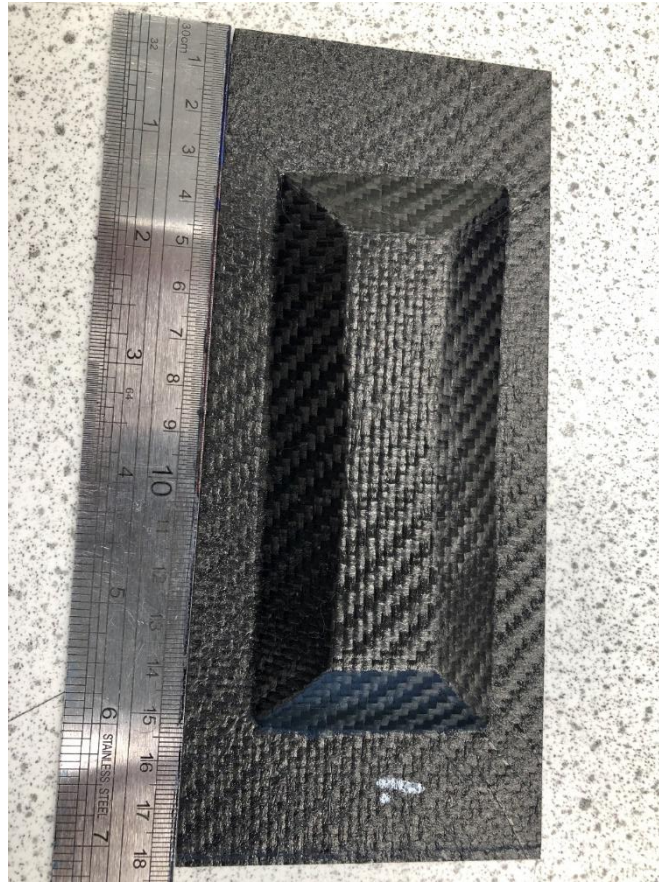
Photograph 44 – showing the candidate checking the core width. Note: poor consolidation of laminates around the core to laminate transition.



Photograph 45 – showing candidate checking straightness of long core length dimension.



Photograph 46 – showing candidate checking straightness of long edge. Note: some taper of the laminate at the top edge. The core is also not sat straight onto the lower laminate.



Photograph 47 – showing candidate checking straightness of short edge. Note: the tapering of the edge and lack of straightness.



Photograph 48 - showing check of surface finish and warp and weft patter. Note: a warp or weft position is selected, and a check is made to ensure that the feature remains constant along the length of the assembly. Some tapering of this is evident.



## Candidate evidence

### 3b. Completed quality check sheet

Feature	Criteria to be met	Met	Not met	Notes
Base dimensions	180mm X 80mm ± 0.5mm		✓	2mm out of square. The base was not square, one long side was not straight. Too much material removed.
Thickness	2mm ± 0.4mm	✓		2mm ± 0.4mm Some inconsistencies – poor consolidation?
Core height	10mm ± 0.5mm	✓		10mm ± 0.5mm Partially crushed core – over consolidation?
“A” side	Flat and clear of FOD	✓		Some FOD present. Some tearing out noticeable. Mould edges not cleaned thoroughly enough.
Moulding	No evidence of bridging or surface wrinkling.	✓		Not equally bonded in places. Some creases from the bag.
Core	Not out of square with the base	✓		Angles were not as clean as expected – need to improve marking out and cutting skills for better accuracy.
All edges	Edges to be made safe, square and parallel		✓	Edged – some dimension tolerances were missed on one edge – over abrasion.
Final spacer block assembly	The spacer should be well presented, free from defects with dimensions meeting the specification and no evidence of FOD or fibre orientation misalignment.	✓		Acceptable appearance, some minor defects to top and A side. Edges were not square with the top and bottom sections. Tap test performed – some indication of debonding.

### 3b. Practical observation form – Quality review

<b>Assessment ID</b>	<b>Qualification number</b>
8713-332	8713-332
<b>Candidate name</b>	<b>Candidate number</b>
Candidate A	CG12345
<b>Centre name</b>	<b>Assessment theme</b>
City & Guilds	Quality review and evaluation

Complete the table below referring to the relevant marking grid, found in the assessment pack. Do not allocate marks at this stage.

<b>Task</b>	<b>Notes</b> – <i>detailed, accurate and differentiating notes which identify areas of strength and weakness are necessary to distinguish between different qualities of performance and to facilitate accurate allocation of marks once all evidence has been submitted.</i>
Quality inspection and application of measuring equipment	<p>The candidate used their quality check sheet to record their findings whilst carrying out a quality check of the spacer block. The candidate added an additional column to record some notes of their observations. This was not initially considered during the planning stage.</p> <p>Dimensional checks were completed. Measuring tools were selected and used with some accuracy. Measuring equipment was not cleaned before use. The appropriate measuring equipment was selected when measuring each part of the spacer block. Most dimensions and findings were recorded on their quality check sheet. Most tolerances within the brief were met, some measurements were out of tolerance. Candidate did not measure a dimension more than once before recording the dimension.</p> <p>Visual and soundness checks were completed. Some defects were present within the finished spacer block, notably some FOD, dust debris which has not affected the overall performance of the spacer block. The candidate recorded this on their form and noted a brief reasoning for their occurrence. Repair options not noted. The rigidity of the spacer block was checked, a tap test was performed, some areas of lifting and debonding observed, rigidity was acceptable but some loss of strength.</p> <p>Overall, this was an acceptable attempt to manufacture a spacer block.</p>
<b>Assessor signature</b>	<b>Date</b>
Assessor A	19.12.2022

## Commentary

*This commentary also covers the completion of the quality check sheet.*

The observation report shows that the candidate has demonstrated a basic understanding of the quality inspection process and the checks needed to be performed.

The candidate utilised measuring equipment to perform the checks on each of the components to record the final dimensions and to check for compliance with tolerances against the brief. The candidate did not check the measuring equipment before use or make sure it was clean and free of debris, which could affect the accuracy of the measurements taken.

All dimensions and components were checked for accuracy against the dimensions and tolerances in the given specification and recorded. Some dimensions were within the given tolerances, but some were just out of tolerance. The candidate could have accessed higher marks if more of the final dimensions had met those in the brief.

The candidate performed checks for soundness by completing a tap test to detect the presence of delamination or debonding which is good practice for this type of composite structure. The result of the tap test result was recorded but more detail could have been given.

The candidate performed dimensional checks, soundness checks and a surface check for defects, recording their findings on their check sheet (from task 1). Some defects were identified and recorded with limited reasoning recorded in the commentary column. The candidate could have accessed higher marks if they had included more detailed commentary, for example, describing with some reasoning the defects identified and the repair needed and what the implications would be to perform a repair e.g. time, cost etc.

The candidate has utilised the quality check sheet template from task 1. The candidate has added a column to capture their findings, this was an oversight in their planning. The check sheet contains a basic level of information, set out clearly and shows the candidate has recorded the findings. The candidate demonstrated a lower level of understanding of the reasons for some of the defects and inaccuracies incurred during the process, for example, being uncertain of the reason for the crushed core, citing over consolidation, which is actually a correct assumption. The candidate could have developed their response if the quality check sheet had included more detail within the comments column. For example, more detail regarding the final edging of the spacer block could have been added, including which edges or sides of the block were over abraded and the method of abrasion used.

*Note: The candidate may choose to use the quality inspection report in the task 3b to record their reasonings for the defects analysis. The assessor should utilise all the evidence presented within task 3 when attributing the marks in the marking grid.*

## Candidate evidence

### 3b. Quality inspection report

#### Quality Inspection Report

##### Introduction

The assignment brief was to produce an assembly to be used as a spacer block within the aerospace industry to ensure the correct spacing of wing skins in a jig during the manufacturing process. To produce the block, I followed a series of composite manufacturing processes. When completed the spacer block assembly was quality checked.

##### Composite manufacturing processes

The spacer block was constructed using pre-preg composite material. The spacer block consisted of components that had a number of plies, these included the lower ply, upper ply and a core. These were measured, marked out and cut to the required size and then laid up on a prepared mould or directly on the foam core material to form the main component part. The mould was then consolidated using the vacuum bagging method. A vacuum was applied to remove the air between the vacuum bag and the mould causing the composite material to be consolidated. A drop test was performed to check for air leaks. The mould was then cured in an oven for 8 hours. After curing, the upper ply component was safe edged and abraded to the required dimensions. The assembly process repeated the laminating, consolidation and curing processes to join the upper and lower layers to create the completed assembly. This was then cured and trimmed to the required dimensions.

##### Product inspection

I carried out a full quality inspection on the completed spacer block assembly. This included a visual check; dimensional accuracy check and a test for soundness.

I prepared my work area and collected my tools and equipment. I selected a steel rule and a digital vernier calliper to measure the finished dimensions of the individual components. The vernier calliper was checked and had been recently calibrated. I add a column to my check sheet to record some notes.

I completed a visual check of the completed assembly to check the finish and identify any visible defects. The edges were not square with the top and bottom sections giving an uneven appearance to the spacer block. The core angles were not as clean as expected but the orientation was within tolerance. The "A" side contained some FOD, mostly likely dust debris which is a defect.

Dimensional checks were completed. I used the steel rule to measure the sides of the block and the vernier calliper to measure the core height. The final dimensions and findings were recorded on the quality check sheet. Most tolerances were met, some measurements were out of tolerance these included the edges which had been over abraded and the base was not square.

A tap test was performed to check the soundness of the assembly and to identify any areas of delamination. There were some areas of lifting and debonding, the rigidity was acceptable but there would be some loss of strength to the assembly.

A copy of my quality check sheet is included below:

Feature	Criteria to be met	Met	Not met	Notes
Base dimensions	180mm X 80mm ± 0.5mm		✓	2mm out of square. The base was not square, one long side was not straight. Too much material removed.
Thickness	2mm ± 0.4mm	✓		2mm ± 0.4mm Some inconsistencies – poor consolidation?
Core height	10mm ± 0.5mm	✓		10mm ± 0.5mm Partially crushed core – over consolidation?
“A” side	Flat and clear of FOD	✓		Some FOD present. Some tearing out noticeable. Mould edges not cleaned thoroughly enough.
Moulding	No evidence of bridging or surface wrinkling.	✓		Not equally bonded in places. Some creases from the bag.
Core	Not out of square with the base	✓		Angles were not as clean as expected – need to improve marking out and cutting skills for better accuracy.
All edges	Edges to be made safe, square and parallel		✓	Edged – some dimension tolerances were missed on one edge – over abrasion.
Final spacer block assembly	The spacer should be well presented, free from defects with dimensions meeting the specification and no evidence of FOD or fibre orientation misalignment.	✓		Acceptable appearance, some minor defects to top and A side. Edges were not square with the top and bottom sections. Tap test performed – some indication of debonding.

## Evaluation

If I were to repeat this assessment I would like to improve:

- mould preparation – clean the mould more thoroughly so the vacuum bag had better adhesion
- measuring and marking out process – better accuracy to ensure that the dimensions would be to the required size
- finishing process – to be more accurate when safe edging and finishing the block to avoid removing too much material at once
- in-production checks - to carry out more checks during the production of the upper ply and core to check the sizes
- assembly – better accuracy lining up the upper and lower plies

- defects - I would pay more attention to the cleanliness of my workstation after safe edging and finishing and be more thorough in the removal of dust and debris and to wipe down surfaces to remove dust particles to minimise the chance of FOD.

### **Conclusion**

The design for the spacer block is good and would be suitable for the purpose it was intended. Whilst the process is effective, the pre-preg material and manufacturing process is expensive. I would suggest using a different material or consolidation method; as the vacuum bag method is difficult to create, air leaks can occur, the process is time consuming and no materials used in the process can be recycled.

## **Commentary**

The candidate has given a brief description of the methods and techniques undertaken to produce the spacer block assembly and the process of performing the quality testing. To develop their response, the candidate could have provided more detail, for example, they could have included reference to in-production checks that were carried out during the production of the components and explained their purpose.

Evaluation is basic and the candidate has identified a range of improvements to their own performance but has only provided a list with brief justifications.

The candidate has identified some areas for their improvement in their performance and has recorded their concessions and some difficulties encountered during the production of the components. They provided a brief reasoning for why the concessions had occurred; but this was lacking in detail. They did not mention the over consolidation of the core and why this had occurred and how it could be prevented in the future.

The candidate could have developed their response further if they had provided more detailed justifications and had given consideration to preventative measures. For example, giving more explanation around the foreign object debris (FOD) and what preventative measures they had taken.

The candidate has suggested improvements for the process which was to consider using an alternative material or consolidation method due to the issues they had with the creation of the vacuum bag and that the process is wasteful as the materials used cannot be recycled. The candidate has demonstrated some basic understanding, identifying that the vacuum bag method is difficult to create and creates a lot of unrecyclable waste due to the resin leakage that occurs during the curing stage. However, some difficulties the candidate faced when constructing the vacuum bag was caused as a result of the candidate not removing all the residue from the mould during the preparation stage, something which they cite later as a personal performance improvement.

The report is structured appropriately with an introduction, overviews for the production and quality testing, evaluation and conclusion. The inclusion of the completed quality check sheet gives the finished sizes of the components and has captured the key data showing whether the component met the required dimensions and criteria.

A basic level of industry terminology has been used consistently throughout.

## **Task 3c – Handover meeting**

**(Assessment themes: Health and safety, Quality review and evaluation (quality review, reporting, recording and handover))**

For task 3c, candidates must provide the following evidence for handover:

- quality inspection report
- the completed spacer block assembly.

For task 3c, assessors will need to produce the following pieces of supporting evidence:

- assessor observation:
  - handover meeting.

### **Video evidence required:**

- video evidence of the handover meeting being undertaken.

The following task 3c supporting evidence has not been included for this version of the GSEM:

Video evidence

- video evidence showing the handover meeting.

### 3c. Practical observation form – Handover meeting

<b>Assessment ID</b>	<b>Qualification number</b>
8713-333	8713-333
<b>Candidate name</b>	<b>Candidate number</b>
Candidate A	CG12345
<b>Centre name</b>	<b>Assessment theme</b>
City & Guilds	Quality review and evaluation

Complete the table below referring to the relevant marking grid, found in the assessment pack. Do not allocate marks at this stage.

<b>Task</b>	<b>Notes – detailed, accurate and differentiating notes which identify areas of strength and weakness are necessary to distinguish between different qualities of performance and to facilitate accurate allocation of marks once all evidence has been submitted.</b>
Handover meeting	<p>The handover meeting was brief. The candidate handed over the completed moulding and their quality inspection report. The candidate demonstrated a basic knowledge of most of the manufacturing processes undertaken. They briefly described their brief and the processes they had undertaken to manufacture the assembly. The responses were brief and lacking in depth.</p> <p>The candidate briefly described the quality inspection process undertaken and the recording of the final dimensions. They described the problems they encountered during the production of the components. They described how they had not cleaned the mould tile thoroughly enough at the start which became a problem during the consolidation stage when the peel ply would not adhere to some areas of the tile, due to the old residue. The candidate said that in future they would be more thorough, so this did not reoccur. The candidate also mentioned the defects that the final spacer block had, describing how they would make sure to select their tools more carefully, referencing the lifting tool used in demoulding. The candidate described how the tool selected was too thick which caused a small crack to one corner when too much pressure was applied. Some preventative measures were offered but this was not detailed.</p> <p>The candidate did not detail all the defects within the spacer block, the issues around bridging of the material over the core, the lack of consistent bonding of the two sections and the area that had resin impregnated into the “A” surface as a result of not cleaning the mould properly were not mentioned.</p>

<b>Task</b>	<b>Notes</b> – <i>detailed, accurate and differentiating notes which identify areas of strength and weakness are necessary to distinguish between different qualities of performance and to facilitate accurate allocation of marks once all evidence has been submitted.</i>
	The candidate spoke clearly and mostly used the correct technical terminology, but their meaning was understandable.
<b>Assessor signature</b>	<b>Date</b>
<b>Assessor A</b>	<b>18.12.2022</b>

## Commentary

The observation evidence has captured the requirements of the handover assessment themes.

The account of the handover indicates that the candidate had shown acceptable subject knowledge and understanding in describing the manufacturing processes undertaken to produce the spacer block assembly.

They gave brief summaries of the processes undertaken and only mentioned some of the issues they encountered. The candidate did not fully explain the reasons for all of the defects in their spacer block, for example, the candidate did not explain the crushed core or the issues around bridging of the material over the core, the lack of consistent bonding of the two sections and the area that had resin impregnated into the “A” surface as a result of not cleaning the mould properly were not mentioned.

The report states that the candidate demonstrated some good communication skills, spoke clearly, presented themselves professionally and mostly used the correct industry terminology but it contained some inaccuracies and inconsistencies, but the meaning was understood by the supervisor, showing a basic level of understanding of industry terminology.

The candidate could have further developed their response if they had provided more detailed descriptions of the processes they undertook, the issues they encountered and explained if the defect could be repaired or what the implication would be if the assembly had to be scrapped, for example, time and cost. In addition, further development would have been demonstrated if they had used the correct terminology throughout.

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