HM Government

T-LEVELS

T Level Technical Qualification in Maintenance, Installation and Repair for Engineering and Manufacturing (8712-33)

Maintenance Engineering Technologies: Electrical and Electronic (313)

Guide standard exemplification material

Threshold Competence – Sample 2022

City & Guilds

First teaching from September 2022
Version 1.1

Version and date	Change detail	Section
1.1 Jan 2023	Minor typographical amendments	Through document

Contents

Introduction

The sample assessment materials within this document refer to the Maintenance Engineering Technologies: Electrical & Electronic 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 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 including any photographic evidence. 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
- Task 2
- Task 3
- Task 4

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.

Commentary section
This section includes detailed comments to demonstrate how the candidate evidence attests to the 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 be able to:

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

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

Demonstrate basic technical skills for diagnosing components, assemblies and sub-assemblies to complete maintenance, installation and repair activities in line with the requirements of the brief.

Demonstrate adequate skills using tools and equipment for electrical and electronic maintenance, installation and repair, ensuring safe isolation, removal and replacement of components.

Demonstrate basic knowledge and understanding of the principles and processes required for disassembly, repair, configuration and re-assembly of electrical and electronic systems, ensuring that most tolerances and calibrations are in-line with specification.

Work safely showing an understanding and suitable level of awareness in the preparation and application of processes, selection and use of tools, equipment, materials and components for maintenance, installation and repair activities.

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

Task 1 – Plan and prepare for the maintenance activities

(Assessment themes: Health and safety, Planning and preparation, Systems and components)

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

a) list of requirements and resources, including justifications for the selections
b) completed risk assessment
c) method statement.

Candidate evidence

1a. List of requirements and resources, including justifications for the selections

Requirements and Resources	Quantity	Justification
Tools/equipment/materials		
230 V power supply	1	Provides the input mains power to the system.
Transformer	1	To reduce the input voltage, spare part for possible replacement.
Capacitors	2	Spare components for possible replacement.
Diodes	4	Spare components for possible replacement.
Voltage regulators	1	Spare component for possible replacement.
Soldering equipment	1	Joining and removing components and wires to circuit board.
Solder reel	1	Joining components and wires to circuit board.
Screwdrivers	3	Different types of screwdrivers for different activities.
Wire cutters	1	Snipping and cutting wires to size.
Wire strippers	1	Removing insulation from wires.
Crimp connectors	4	Connecting electrical wires and cables.
Crimping tool	1	To make joins between wires and cables.
Wire reel	1	Replace any damaged wire in the system.
Multimeter	1	Measuring electrical values.
Oscilloscope	1	Measuring electrical waveforms.
PPE		
Gloves	1	To reduce chances of injury to hands.
Overalls	1	To protect the body from dirt and solder flux residue.
Safety glasses	1	To reduce chances of injury to eyes.
Warning signs and notices		To indicate electrical supplies are isolated.
Technical Information/documentation		
Manuals	For the transformer.	
Datasheets	Technical information about each component.	
Risk assessment	To complete before beginning the task.	
Method statement	To follow during the task.	

Waste disposal	Wiring, electrical and general waste separated.
Time needed	Work area 1 hour Inspect 4 hours Repair 3 hours Return to service 2 hours
Access requirements	None.
Fault finding/diagnostic techniques and methods	
Visual inspection - checking for any visual faults/components not connected etc.	
Input to output - what's expected happens, operates as expected.	
Half split technique - break the system down to locate the fault.	

Commentary

The candidate has interpreted the requirements of the brief and applied their understanding to produce an adequate list of resources required, demonstrating technical knowledge for the system and maintenance requirements. For example, recognising the need to measure both electrical values and waveforms and the need for technical information from component datasheets. The candidate has identified the need for different electrical tool types, such as soldering equipment and crimping tools. This could be developed further by detailing the specific soldering equipment required, for example soldering iron, sponge, stand, de-soldering pump and portable extraction unit.

The candidate has listed the amounts of each resource that they have planned to use, however they have not taken into account the need for additional spare components beyond the bare minimum for the circuit, should further issues or problems arise. This demonstrates that time saving, and system downtime may not have been considered in their planning and preparation.

The candidate has recognised the need to refer to supporting technical documentation in order to complete the task. There is limited detail provided on what documentation they would use, with no specific reference to assignment brief, specification, or diagrams – which could lead to errors or ineffective time management. This is also shown in their planned timings which only account for 10 of the 11 hours allocated for the task.

The candidate has interpreted the technical information, including the circuit schematic and block diagram, to identify fault finding and diagnostic techniques and methods that are appropriate for the system to correctly diagnose faults, and inform the appropriate resolution methods. They have not provided justifications or details of the methods, demonstrating knowledge of the processes to be followed but not fully understanding the reasoning behind them.

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, such as ensuring overalls are made from heat resistant materials. To develop this area further, additional pieces could also be listed, such as closed-toe shoes to protect feet against any falling or dripping solder.

1b. Risk assessment

Risk Assessment				
Hazard	Risk	Control	Likelihood	Severity
Working area throughout the maintenance and fault finding activities	Slips, trips and falls.	Ensure area is clean and tidy throughout preparation, maintenance and upon completion. Wear PPE at all times.	1	1
Manual handling of tools and equipment needed for maintenance	Back injury.	Do not lift over maximum lifting limit. Ensure correct training has been received.	1	1
Undertaking maintenance with stored electric energy	Burns, electric shock.	Ensure that correct procedures are followed and all stored energy is safely discharged. Observe cool down periods.	3	2
Using soldering equipment for joining components	Burns, electric shock.	Keep hands away from tip of soldering iron or hot solder. Wear safety glasses.	3	2
Using general hand tools and equipment for maintenance activities	Cuts, abrasions, general hand injury.	Ensure proper use of tools and equipment, particularly wire cutters, strippers and crimpers. Ensure correct PPE is obtained and used throughout to protect from injury, such as gloves when working with hot components and safety glasses to protect from flying debris e.g. when snipping wires.	1	1
Undertaking maintenance activities where electricity is present (mains and low voltage)	Electrocution.	Safe isolation following ELV guidance.	3	4
Equipment malfunction/faulty components	System heating up when working on it.	Safe isolation following ELV guidance.	2	2

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 death

Commentary

The candidate has considered and identified hazards and risks associated with the maintenance and fault finding activities on the system to ensure safe working is followed. All risks and hazards identified are relevant to the task and system to be work on demonstrating their understanding of risk identification and mitigation whilst completing maintenance activities. To develop the response further, the candidate could categorise each element of the activity and identify hazards for each part, demonstrating a deeper understanding of risks and hazards in the workplace to ensure the safety of themselves and others. For example, the specific hazards related to the different stages of soldering – safe storage of solder, heating the soldering iron, applying solder to joints and extraction of fumes.

The candidate has considered an appropriate control measure for each of the hazards identified, demonstrating acceptable knowledge for risk mitigation techniques in order to demonstrate that they are able to work safely. However, the measures identified lack specific detail, and do not appear to demonstrate that the candidate has considered a variety of scenarios or situations that could arise during the maintenance activities. Further consideration of a wider range of control measures and a greater level of detail would have developed the candidate's response further. For example, visual inspection of flex on the soldering iron to check it is electrically safe prior to use.

The candidate has labelled the likelihood severity for each risk and hazard, with some accuracy. For example, electricity is correctly spilt into mains and low voltage, with ratings of 3 for likelihood and 4 for severity. This demonstrates an acceptable standard of understanding and awareness of risk assessment and mitigation, and therefore safe to work. The candidate could have developed their response further by considering the likelihood/severity of all identified hazards and risks with a higher degree of accuracy. For instance, acknowledgement that risks may only cause minor injury, but would be of a higher likelihood rating, such as general hand tools and equipment should be rated as 2 for likelihood, and 1 for severity, rather than 1 for both).

1c. Method statement

Maintenance

- Collect my PPE, tools and equipment that will be needed for the task.
- Put on PPE and visually check the work area.
- Remove any objects or items that may cause injury and put out warning signage.
- Adhere to the Health and Safety at Work Act.
- I will power down the system and remove any fuses.
- I will then isolate the system following safe isolation procedures.
- I will safely release stored electrical energy from the capacitors.
- I will perform an initial visual inspection of the system.
- I will then check wiring connections of components.
- I will check the transformer for damage or frayed insulation.
- I will check the PCB for any dry or loose solder joints and that all components are correctly fitted in place.

- I will test each block of the system to check the output signals are as expected and record my results on the test record sheet.
- I will use fault finding techniques to identify any components or system blocks not producing the correct outputs, and either repair or replace the affected components as necessary.
- I will ensure the system is fully and correctly reassembled as per the circuit schematic and block diagram.
- I will check that everything is wired and soldered back up correctly and give a general inspection of the system before putting the power back to the system.
- Once the system is powered back up, I will complete a function check.
- I will complete the appropriate stock records to ensure any used stock can be replenished.
- I will then tidy up the working area, taking tools and equipment back to the correct place and ensuring that any waste is dealt with correctly.
- I will then handover the task to my supervisor.

Commentary

The method statement is clear and demonstrates basic knowledge and understanding for the maintenance processes to be undertaken, with an appropriate sequencing of tasks. The response could have been developed further with greater detail of what they plan to do, communication with others working in the area and planning for a variety of scenarios arising.

The candidate has considered and referred to one regulatory requirement, the use of PPE and ensuring working area is checked, demonstrating the candidate has considered and plans to follow workplace regulations. The response could have been developed by referring to a wider range of regulatory requirements, such as WEEE waste disposal and guidance documents, and how they are applied.

The method statement lists the candidate's proposed actions in a bullet list form which can be easily followed in Task 2, however is lacking detail of intended actions and techniques at each stage. Whilst the evidence demonstrated shows adequate planning skills, the candidate could have developed their response further by providing justifications for, and showing further detail of, the actions to be taken. For example, when describing the functional checks, the candidate could have stated what exactly was to be checked, how and why, such as measurement of output voltages signals from each system block to confirm functionality, and comparison to expected and/or previously measured values.

Task 2 – Perform the maintenance activities

(Assessment themes: Health and safety, Systems and components, Working with faults, Reviewing and reporting)

For task 2 candidates need to produce the following pieces of evidence from completing the maintenance activities:

- completed test record sheets
- updated maintenance records and control documents
- annotated method statement, including any recommendations for further investigation if required.

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

- assessor observations of:
    - work area preparation
    - the maintenance activities.

Photographic evidence required:

- Photographic evidence showing the prepared work area - Illustrated in Task 2 photographic evidence section below (photograph 1)

- Photographic evidence showing the working area after removal of casings and disassembly - Illustrated in Task 2 photographic evidence section below (photograph 2)

- Photographic evidence showing faulty components prior to repair or replacement, clearly showing the cause of each fault - Illustrated in Task 2 photographic evidence section below (photographs 3, 4 and 5)

- Photographic evidence showing replaced or repaired components in situ, including any solder joints or other connections made - Illustrated in Task 2 photographic evidence section below (photograph 6)

- Photographic evidence showing the re-instated work area – Illustrated in Task 2 photographic evidence section below (photograph 7)

Candidate evidence

2. Completed test record

Test record sheet - 03/04/2022

Actions completed -

- Planned maintenance and inspection of system completed.
- Initial electrical measurements taken.
- Faults with the transformer and rectifier stages of the circuit found and resolved.

System was then ready for final testing.

Testing of the system

Measurements taken -
The table below shows the output signal values measured using a multimeter and oscilloscope.

Circuit/system block	Expected output V	Output V from initial tests
Transformer	12 V AC	12 V AC but with intermittent spikes
Rectifier	12 V DC with fluctuations	0 V
Filter	12 V DC without fluctuations	0 V
Regulator	5 V DC	0 V

Measurements confirm problem with transformer and rectifier circuit.

Other tests completed -

- Power supplied back to the system and re-energised.
- Checked that the system was running.
- Made final checks to components, wiring and soldered joints.
- Checked the final system output voltage – measurement now taken at 3.3 V DC.

Testing of the AC-DC converter system is now complete, and the system can be handed back over to the supervisor. The next step is to complete the maintenance log with details of work completed and review control documents.

Commentary

The candidate has completed a basic test record that adequately details the actions taken and testing completed. The record is reflective of the completed tests, but to further develop the response the candidate could have taken further measurements of additional parameters, such as current, resistance and signal waveforms. Each stage undertaken has

been listed but with limited detail on what was undertaken. They have recorded the results of initial numerical tests and displayed these clearly in a table against the expected results.

To develop the response further, the candidate could include the results of the final output voltage tests for each individual block of the system, post maintenance and fault diagnosis, and how these compare directly to the initial measurements taken. They could have shown awareness of issues still existing from the final tests completed, for example the regulator not producing the required 5 V output. They could also have explained how testing was completed in more depth, using more detailed technical terminology.

2. Updated maintenance records and control documents

Maintenance log							
			System type:	AC-DC Converter System			
			System TAG number:	1A2B3C			
			Department responsible for equipment:	Maintenance engineering department			
Date:	**Maintenance performed by:**	**Maintenance description:**	**Work completed outside the scope of the maintenance:**	**Are any problems identified rectified? Y/N**	**Validation performed by:**	**Next maintenance due date:**	**Comments:**
03/04/2022	Candidate.A	Scheduled maintenance and intermittent fault diagnosis.	The system was not producing the required voltage output. The transformer was found to have damaged insulation and was replaced. Checks were completed on the wiring connections and solder joints to the circuit board. A rectifier diode was re-soldered as one of the joints was shorted.	Y		03/04/2022	The job has been completed, but the system is still only producing an output of 3.3 V with some large fluctuations to the signal. Further inspection will be needed to investigate the cause of this. Also recommend the maintenance schedule is revisited.

Controlling of documentation log				
Date:	**Checking of documentation performed by:**	**Are diagrams and specifications up to date?**	**Are risk assessments in date and applicable to the task?**	**Any issues with diagrams and specifications to report:**
03/04/2022	Candidate.A	Yes.	Yes. Area risk assessment has been checked and is in date.	All documents are complete, valid and in date.

Commentary

The candidate has filled in the maintenance log correctly, information provided is relevant and complete with minimal errors. They have recorded the maintenance carried out including repairing faults with the transformer and rectifier diode. They have also recognised and recorded that the circuit is still not producing the required output as not all faults were found, and hence have recommended that further inspection is carried out.

To develop the response further, more information and detail could have been recorded on the form. For example, reference to the results of initial testing measurements taken. The candidate could also have amended the next scheduled maintenance date to take into account that further maintenance is needed for the system to be brought back to fully operational status, as per the specification requirements.

The candidate has completed the control documentation with basic detail, confirming documentation used is up to date. To develop the response further, the candidate could add additional detail which could be referenced easily in future, such as the document version number, any recommendations to update the documents and the reporting process where any errors are identified.

2. Annotated method statement

Maintenance

- Collect my PPE, tools and equipment that will be needed for the task.
- Put on PPE and visually check the work area.
- Remove any objects or items that may cause injury and put out warning signage.
- Adhere to the Health and Safety at Work Act.
- I will power down the system and remove any fuses.
- I will then isolate the system following safe isolation procedures.
- I will safely release stored electrical energy from the capacitors.
- I will perform an initial visual inspection of the system.
- I will then check wiring connections of components.
- I will check the transformer for damage or frayed insulation.
- *I found that the transformer had damaged insulation.*
- I will check the PCB for any dry or loose solder joints and that all components are correctly fitted in place.
- I will test each block of the system to check the output signals are as expected and record my results on the test record sheet.
- *I found that the transformer was only producing the required output intermittently and with some large voltage spikes. The other parts of the circuit were producing no voltage output, indicating at least one other fault.*
- I will use fault finding techniques to identify any components or system blocks not producing the correct outputs, and either repair or replace the affected components as necessary.
- *I used the half split technique to find a shorted rectifier diode and repaired the connection. I replaced the damaged transformer.*
- I will ensure the system is fully and correctly reassembled as per the circuit schematic and block diagram.
- I will check that everything is wired and soldered back up correctly and give a general inspection of the system before putting the power back to the system.
- Once the system is powered back up, I will complete a function check.
- *Function check showed an output voltage of 3.3 V DC from the system. This is much closer to the required output of 5 V DC but still lower than required.*
- I will complete the appropriate stock records to ensure any used stock can be replenished.
- I will then tidy up the working area, taking tools and equipment back to the correct place and ensuring that any waste is dealt with correctly.
- I will then handover the task to my supervisor.

Commentary

The candidate has demonstrated basic knowledge and understanding of the steps to correctly complete the maintenance on the system in order to diagnose and resolve faults.

The candidate has indicated at what intervals the scope of work changed from their planned method statement with a factual account of what was observed, showing interpretation of the system and fault detection results as they were working on the system. To further develop the response, the candidate could have provided further detail on what fault resolution methods were chosen and what detection and diagnosis information led to them. For example, how they applied the half split technique to narrow down the location of faults to find the root cause, justifying how this allows for fault identification at a component level, rather than system block level.

2. Practical observation form – work area preparation

Assessment ID	Qualification number
8712-313	8712-33
Candidate name	**Candidate number**
Candidate A	CG12345
Centre name	**Assessment theme/s**
City & Guilds	Health and safety Planning and preparation

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

Task	**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.*
Work area preparation	The candidate gathered the tools, equipment and PPE listed in their resources list and checked the condition and calibration date of each. There did not appear to be any logical sequencing of tools and equipment placement in the working area. Visual inspection undertaken. Technical information, including their risk assessment, placed within reach of the working area, ensuring all basic health and safety requirements were followed before the maintenance activities began. Appropriate warning signs and barriers used.

Assessor signature	Date
Assessor.1	02/04/2022

Commentary

The candidate demonstrated an acceptable approach to preparing to work through undertaking basic preparatory checks of the work area. The candidate demonstrated consideration of checks across a range of key areas, such as checking the basic condition of tools and ensuring visual checks of the area.

The candidate could have developed their response by showing a more logical approach to their preparation. For example, resources were placed in the work area, but were noted as not having been considered with any particular workflow or logic in mind. Considering this in

more detail would have shown the candidate's awareness of how this would support the efficiency and accuracy of their work in subsequent tasks.

2. Practical observation form – maintenance activities

Assessment ID	**Qualification number**
8712-313	8712-33
Candidate name	**Candidate number**
Candidate A	CG12345
Centre name	**Assessment theme/s**
City & Guilds	Health and safety Systems and components Working with faults Reviewing and reporting

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

Task	**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.*
Decommissioning, disassembly and inspection	The candidate correctly followed all steps of isolation procedures before starting work on the system. The candidate disassembled the system correctly, referring to their method statement and technical information regularly as an aid. A cool down period of 2 minutes was observed, but could have been longer, 10 minutes would have been appropriate for the system. Stored charge was safely released form the capacitors in the system. Correct sub-assemblies, casings and components removed, disconnecting wires and placed onto bench.
Fault detection and diagnosis	The candidate completed some visual and physical checks, identifying the fault with the transformer. The candidate then performed tests to check each block of circuitry. Attempts were made to use recognised fault diagnosis techniques as outlined in their method statement, with partial success. The candidate correctly identified the shorted rectifier diode using the half split technique but did not locate the faulty filter capacitor or incorrect voltage regulator. Performing additional measurements of both the input and output signals to these blocks may have helped them to achieve this.
Resolution and calibration	The candidate addressed the two faults found, but not in a logical order. They re-made the solder joints so that the diode became functional again. However, the joints were not as neat as they could have been, and too

Task	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.*
Reassembly and recommissioning	much solder was used. The transformer was completely replaced and rewired. The block screw connectors were not fully tightened. The candidate attempted final system calibration, but this was not possible within manufacturer's specifications, as they had not located the faults with the filter capacitor and voltage regulator. The candidate produced solder joints that were of an adequate standard but could have benefited from using more solder to create a more solid joint and taking more care whilst using tools and equipment. Cable terminations had no nicks on the insulation, but wire stripped slightly too much leaving a small amount of exposed copper. The candidate checked the connections to ensure that they were OK. The candidate then re-energised the system and completed a function check. The casings were correctly re-fitted but screw joint could have been neater and left flush.
Working area	The candidate worked safely through all activities, following appropriate workshop requirements. Disconnected wires and components were placed on the bench rather than in containers which could have resulted in a trip hazard if knocked off the bench. The candidate mostly returned tools and equipment to appropriate storage but did not clean down thoroughly.

Assessor signature	Date
Assessor.1	03/04/2022

Commentary

The candidate was able to demonstrate maintenance techniques showing competent and correct use of tools and equipment to ensure the maintenance was completed to an adequate standard, although fault finding was not always completed in the most logical order. For example, beginning work on the transformer before tests had confirmed the nature of both this issue and of the problem with the rectifier diode.

The candidate identified two of the four faults within the system and carried out appropriate resolution methods for these two faults. The candidate could have developed this response further by taking more care and consideration of the quality of these repairs. For example, using less solder which would reduce the possibility of future short circuits and ensuring screw connectors are fully tightened and flush to the block which would reduce the possibility of wires disconnecting in future.

As the candidate had not located the faults with the filter capacitor and voltage regulator, they were unable to complete calibration of the system within manufacturer's specifications. This meant that although they followed the correct process and the system was working, it could not produce fully accurate functions. The candidate could have demonstrated their maintenance ability further by ensuring all of the circuitry was fully operational and working to manufacturer's specifications before undertaking final functional checks.

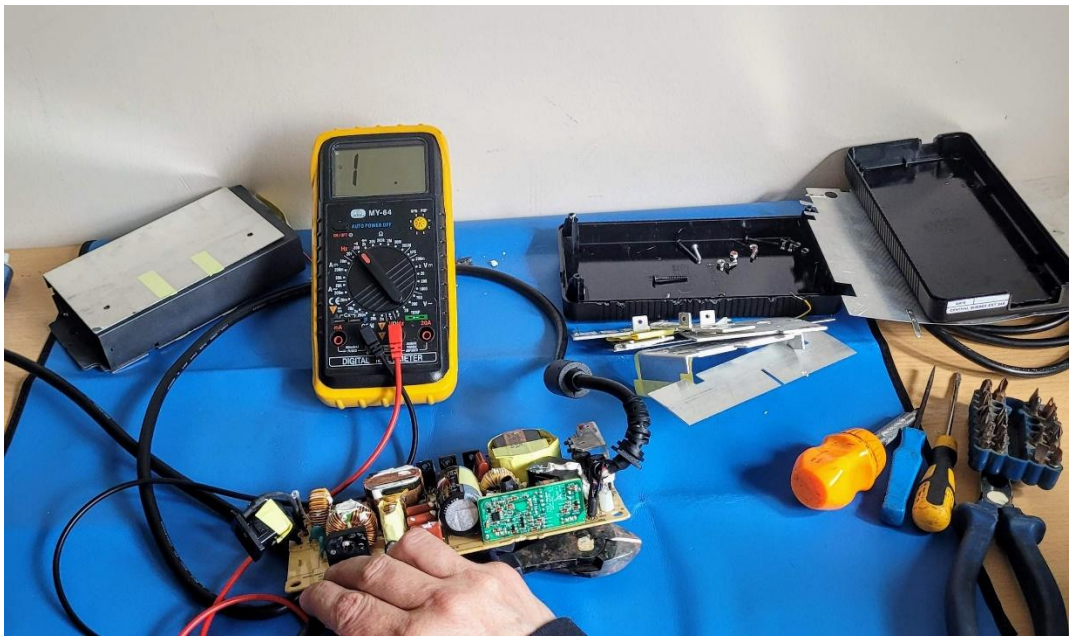
Photographic evidence

Photograph 1: Photographic evidence shows the prepared work area. Tools and equipment have been collected but not set out in a fully logical sequence.

Photograph 2: Photographic evidence shows the working area after removal of casings and disassembly, with parts, components and sub-assemblies placed untidily on the bench rather than in separate containers out of the way.

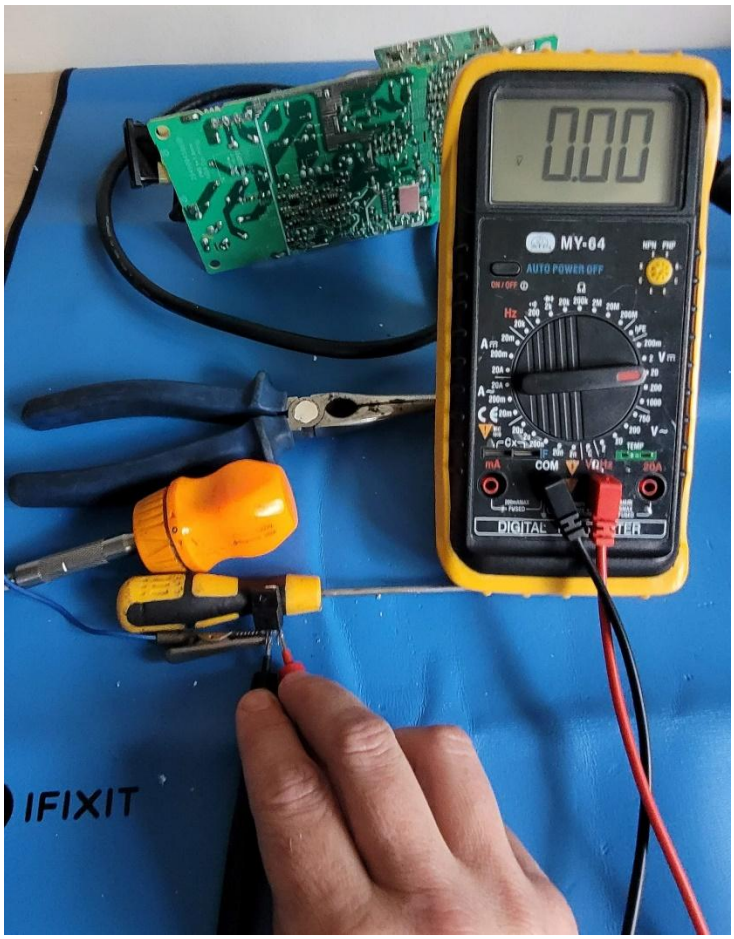
Photographs 3, 4 and 5: Photographic evidence shows the identified faults/faulty components prior to repair or replacement, showing the cause of each fault where possible. The candidate did not identify all four faults within the system.

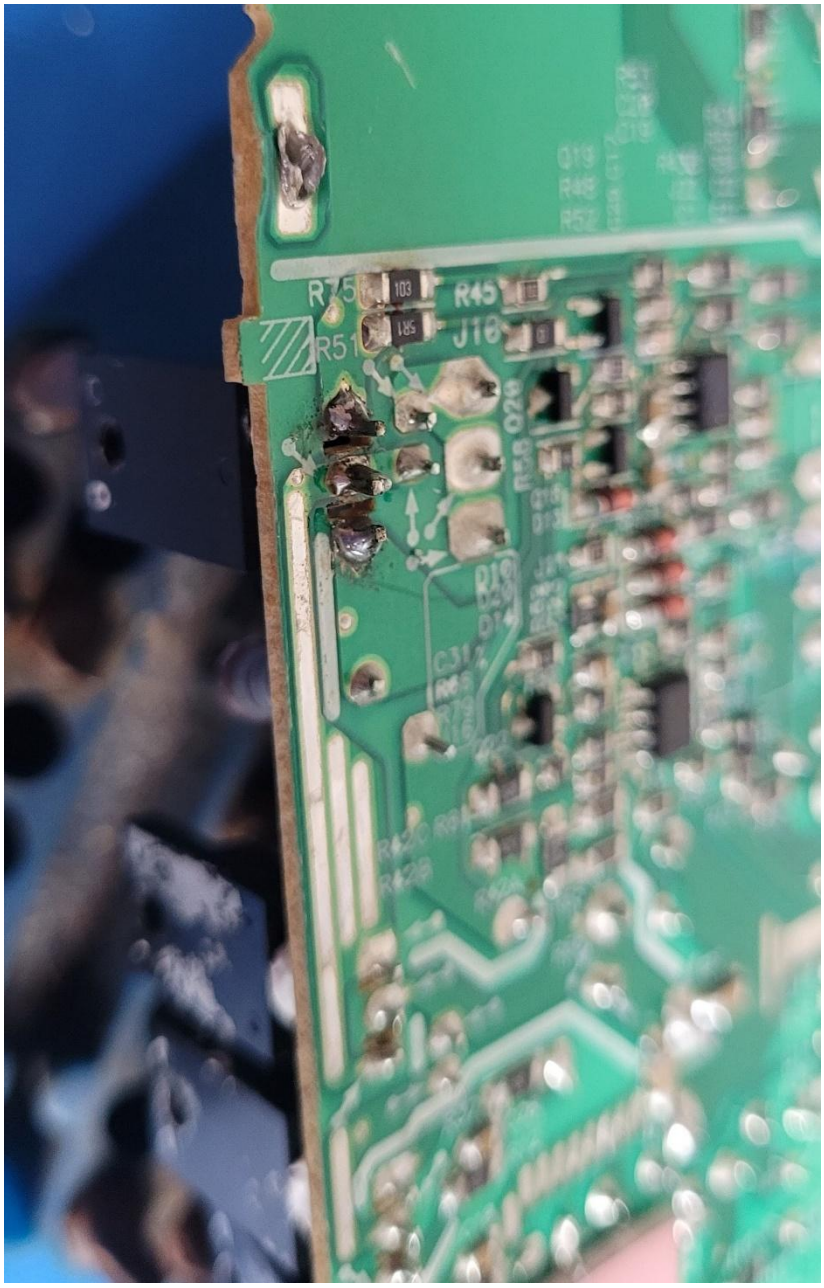
Photograph 3: testing the faulty rectifier.



Photograph 4: faulty wire.

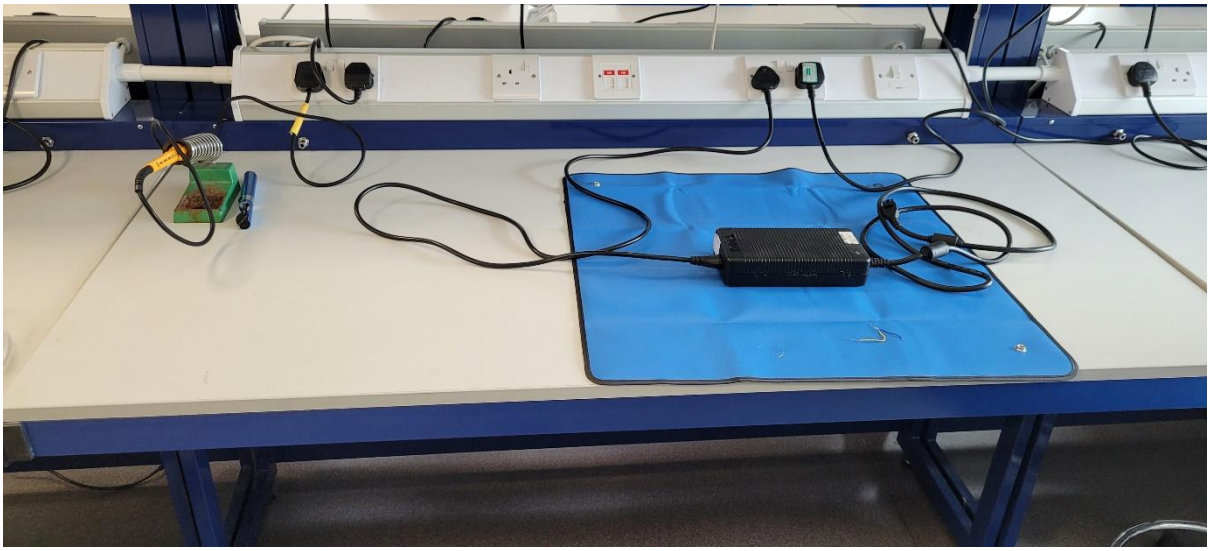
Photograph 5: testing the regulator.





Photograph 6:
Photographic evidence shows solder joint to the main circuit board for the repaired/replaced regulator. Condition and quality is functionally adequate, but is not shaped correctly, not very neat and slightly more solder would have ensured a more long lasting joint.

Photograph 7: Photographic evidence shows the re-instated working area including the AC to DC system, the area is mostly clean and tidy but not all tools and equipment have been returned to the appropriate storage area.



Task 3a - Review and report the maintenance activities

(Assessment themes: Health and safety, Systems and components, Reviewing and reporting)

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

- technical report
- revised maintenance schedule, including justifications.

Candidate evidence

3a. Technical report

AC-DC Converter System	04/04/2022

The AC-DC converter needed the scheduled maintenance to be completed. This involved performing checks and tests on the system and fixing any faults found during the maintenance. A block diagram, circuit schematic and specifications were used to check that the system was working as well as it should.

Before beginning the task, I completed a method statement as requested in task 2. The method statement gave me steps to follow as I worked through the maintenance. I also completed a risk assessment, as this is important for safety, before conducting any work and was also a requirement of the task. I used the scoring table to decide the likelihood and severity of the risks.

Before beginning the task, I gathered all of the PPE and the tools and equipment listed in the materials list. I made sure that the area was clean and tidy before entering the area and setting up the working area, tools and equipment. I made sure the system was isolated, took off the circuit casings and safely removed stored energy from the circuit.

The first task that needed to be completed was visual inspections to check the condition of the system and identify any damage or wear and tear to the system. When doing this I noticed that the transformer had damaged insulation and needed to be replaced. I then took voltage measurements using a multimeter. These showed that the circuitry was not working as expected. I found that a rectifier diode has a short circuit so there was no voltage across it. I repaired the solder joints and this was then working afterwards.

I couldn't see anything else wrong with the circuit, so I decided to make some final tests and re-assemble the system back together and put the casing back on. I re-attached the transformer wires using block connectors and crimps, making sure all solder joints were secure on the PCB. Although a DC output voltage was now being provided, this was still lower than expected at 3.3 V. I am not sure why this is the case, so further maintenance investigation is recommended. I tried using the input to output fault detection technique this time and was unable to find the cause of this so next time I would try unit substitution to check the regulator integrated circuit.

After completing the maintenance task, I made sure that the area was left clean and tidy. I did this by taking all the tools and equipment back to the correct place and putting all rubbish in the bin. Stock used was:

- solder
- 1 transformer

- 1 diode
- single and multi-core wire
- crimp connectors
- block screw connectors.

All waste was disposed of in general waste, segregating the electrical waste and placing that in the designated WEEE bin.

Overall, I managed to complete the maintenance tasks, resulting in a system that changes the 230 V power supply into a lower DC voltage. However, this was still not at the 5 V required by the specification, so further investigation is needed.

Commentary

The technical report provides a basic description of the maintenance activities carried out. Technical terminology is correct but limited. For example, reference is made to finding faults, but the correct diagnosis techniques used are not specifically mentioned.

The candidate has described the main steps that were taken to complete the maintenance activity. The response largely provides a clear, but simplistic overview of what the candidate did, and what happened during the activity. Although the report has been developed following a clear and logical sequence which reflects the activities undertaken, it would benefit from being developed in further detail. The candidate could have developed their response by explaining each of the steps taken in more detail, as well as providing justifications of their actions, showing consideration for the amount of system downtime.

The candidate has recommended further investigation to resolve the outstanding faults they were unable to identify due to an incorrect output DC voltage, recommending unit substitution for further investigation. This technique would not be the recommended fault detection technique to complete as it relies on trial and error, resulting in wasting time and can be costly. To develop the response further, the candidate could have recommended completing further investigation and measurements with the half split technique with further analysis and interpretation of the results to identify the root cause.

The candidate has reported the stock used to complete the maintenance by listing some quantities of components and materials used, and how they disposed of their waste. The response could be further developed by noting exact levels of all stock used, such as the exact amount of solder, and what was left in the stock cupboard, then reporting this to the supervisor.

3a. Revised maintenance schedule

System:	Findings during maintenance:	Recommendations to seniors:	Justification to seniors:	Recommended next planned maintenance due date:
AC-DC converter	Transformer had damaged insulation. Rectifier diode had a shorted solder joint.	Due to outstanding issues remaining with the system I recommend that the maintenance schedule is increased in regularity – every 6 months. Another inspection is needed urgently to identify the continuing issues to complete reactive maintenance.	System is producing a DC voltage of 3.3 V instead of the 5 V expected. Solder joints will need regular checking to avoid short circuits forming again.	03/10/2022 Reactive ASAP

Commentary

The revised maintenance schedule has been completed correctly with minimal detail provided on the findings during the maintenance.

The candidate has considered the outstanding maintenance issues and produced a basic, but accurate, justification for increasing the frequency of scheduled maintenance activities. The candidate has also identified that another urgent inspection is needed due to potentially unresolved faults, but not specified exact timescales for this.

The candidate provided only limited reference to causes or factors that could cause components other than the shorted diode to become unfit for use. Further consideration of additional factors would have demonstrated a broader understanding of the system circuitry and would have further developed the candidate's response.

Task 3b – Peer review

(Assessment themes: Reviewing and reporting)

For task 3b candidates will be asked to peer review two maintenance schedules and then be given two completed peer reviews to review and amend their proposed maintenance schedule. This is supporting evidence for assessors to see what suggestions have been given to each candidate in order to base their amendments on and will not be marked.

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

- maintenance schedule amended from peer review feedback, including justifications.

3b. Peer review forms

Candidate name	**Candidate number**
Candidate.C	34567
Centre name	**Centre number**
ABCDE	12345

Question	**Feedback**
How well does the schedule enable planned maintenance activities to be performed and recorded over time?	*The schedule enables planned maintenance to be completed at more regular intervals which will improve system efficiency. The documents produced allow for the maintenance to be recorded clearly.*
How appropriate are the recommended planned maintenance intervals and why?	*The alteration to the maintenance schedule that is proposed is appropriate for the system, its age and use.*
What are the implications to the business of the proposed maintenance schedule?	*The new maintenance schedule will mean that more time is being spent on the maintenance and have a cost implication, so seniors may not approve the update because of this.*
How can the maintenance schedule could be optimised/ improved?	*I agree with candidate.A's recommendation to reduce planned maintenance from 12 monthly to 6 monthly, but the cost implications to the business will need to be more thoroughly considered. I would recommend additional test measurements to be taken at each planned maintenance activity to be clearly stated in the maintenance schedule so can be recorded each time. Because there was an issue with the rectifier diode, it's likely that this a common issue for this system so I would recommend replacing the rectifier diode each time planned maintenance is carried out to avoid further issues.*

Candidate name	Candidate number
Candidate.D	45678
Centre name	**Centre number**
ABCDE	12345

Question	Feedback
How well does the schedule enable planned maintenance activities to be performed and recorded over time?	*The schedule proposed is suitable, because of the nature of the system and the many elements, as well as the time needed to perform the maintenance.* *The documentation that has been put in place to record the maintenance activities is good.*
How appropriate are the recommended planned maintenance intervals and why?	*The new recommended planned maintenance intervals are a little too long – I think due to safety the circuit needs to be checked at more regular intervals.*
What are the implications to the business of the proposed maintenance schedule?	*Over a long period of time the wiring may become loose which could cut power from the transformer to the circuit. This would mean the system is out of action and reactive maintenance would be needed. This would increase costs and downtime.*
How can the maintenance schedule could be optimised/ improved?	*I think it would be beneficial for the maintenance schedule to be reduced. This would ensure issues due to loose-wiring connections can be found and dealt with sooner. I would also recommend adding a specific timeframe to address the current outstanding maintenance issue rather than stating ASAP.*

Candidate evidence

3b. Maintenance schedule amended from peer review feedback

System:	Findings during maintenance:	Recommendations to seniors:	Justification to seniors:	Recommended next planned maintenance due date:
AC-DC converter	Transformer had damaged insulation. Rectifier diode had a shorted solder joint.	Due to outstanding issues remaining with the system I recommend that the maintenance schedule is increased in regularity – every 6 months. Another inspection is needed urgently to identify the continuing issues to complete reactive maintenance. Upon reviewing of the peer feedback, I recommend that the rectifier diode should be replaced at each planned maintenance interval.	System is producing a DC voltage of 3.3 V instead of the 5 V expected. Solder joints will need regular checking to avoid short circuits forming again.	03/10/2022. Reactive maintenance to be completed by 10/04/2022.
Justification for changes: From peer feedback, it was highlighted that due to outstanding issues within the system, reactive maintenance should state a date for further investigation and resolution to be completed, so I recommend this is completed within a week of today's date. Peer review feedback mostly agreed with the reduced intervals from 12 months to 6 months. It was also recommended to replace the rectifier diode at each planned maintenance activity. This is recommended based on the diagnosed and resolved issue found, and in order to avoid repeat issues with this component as it is a common issue.				

Commentary

The candidate has amended the maintenance schedule and highlighted where changes have been made for easy identification. For example, they have added an appropriate date for the reactive maintenance completion which will ensure this is recorded correctly as well as not prolonging system downtime. This demonstrates their ability to understand and respond to peer feedback received and understanding of the importance of preventative maintenance.

The candidate has taken on board elements of peer feedback and implemented changes where they agreed changes were appropriate. The recommended reduced intervals to carry out planned maintenance demonstrates knowledge and understanding of the benefit of regular planned maintenance to maintain system efficiency and reduce downtime.

Changes made are not always fully appropriate and may be more costly to complete. For example, the rectifier diode does not need to be replaced unless found to be faulty. The candidate has also failed to recognise that in the maintenance carried out, it was the solder connection to the diode that was faulty, not the component itself which the candidate should have identified and dismissed as unnecessary.

The candidate has provided basic justifications for the changes made, for example that reactive maintenance should be completed within one week because of the outstanding issue not yet diagnosed. Justifications for some changes are not fully appropriate though as the rectifier diode failure is not a common issue with this system. The response would have benefited from the candidate detailing more fully the technical reasoning behind decisions to adopt feedback. For example, why it is important for the reactive maintenance to be completed within one week.

Task 4 – Complete handover

(Assessment themes: Health and safety, Reviewing and reporting)

For task 4 candidates need to produce the following pieces of evidence:

- handover documentation.

For task 4, assessors will need to produce the following pieces of supporting evidence from the handover:

- assessor observations of the handover meeting.

The following task 4 supporting evidence has not been included for this version of the guide standard exemplification materials:

- video evidence showing the handover meeting.

Candidate evidence

4. Handover documentation

Maintenance log							
			System type:	AC-DC Converter System			
			System TAG number:	1A2B3C			
			Department responsible for equipment:	Maintenance engineering department			
Date:	**Maintenance performed by:**	**Maintenance description:**	**Work completed outside the scope of the maintenance:**	**Are any problems identified rectified? Y/N**	**Validation performed by:**	**Next maintenance due date:**	**Comments:**
03/04/2022	Candidate.A	Scheduled maintenance and intermittent fault diagnosis.	The system was not producing the required voltage output. The transformer was found to have damaged insulation and was replaced. Checks were completed on the wiring connections and solder joints to the circuit board. A rectifier diode was re-soldered as one of the joints was shorted.	Y	Assessor.1	03/10/2022	The planned maintenance has been completed, but the system is still only producing an output of 3.3 V with some large fluctuations to the signal. Further inspection will be needed to investigate the cause of this. Reactive maintenance to be completed by 10/04/2022.

Controlling of documentation log				
Date:	**Checking of documentation performed by:**	**Are diagrams and specifications up to date?**	**Are risk assessments in date and applicable to the task?**	**Any issues with diagrams and specifications to report:**
03/04/2022	Candidate.A	Yes.	Yes. Area risk assessment has been checked and is in date.	All documents are complete, valid and in date.

System:	Findings during maintenance:	Recommendations to seniors:	Justification to seniors:	Recommended next planned maintenance due date:
AC-DC converter	Transformer had damaged insulation. Rectifier diode had a shorted solder joint.	Due to outstanding issues remaining with the system I recommend that the maintenance schedule is increased in regularity – every 6 months. Another inspection is needed urgently to identify the continuing issues to complete reactive maintenance. Upon reviewing of the peer feedback, I recommend that the rectifier diode should be replaced at each planned maintenance interval.	System is producing a DC voltage of 3.3 V instead of the 5 V expected. Solder joints will need regular checking to avoid short circuits forming again.	03/10/2022. Reactive maintenance to be completed by 10/04/2022.

Justification for changes:

From peer feedback, it was highlighted that due to outstanding issues within the system, reactive maintenance should state a date for further investigation and resolution to be completed, so I recommend this is completed within a week of today's date. Peer review feedback mostly agreed with the reduced intervals from 12 months to 6 months. It was also recommended to replace the rectifier diode at each planned maintenance activity. This is recommended based on the diagnosed and resolved issue found, and in order to avoid repeat issues with this component as it is a common issue.

Commentary

The candidate has provided a copy of the maintenance log, controlling of documentation log and updated maintenance schedule, obtained a signature from the supervisor to show that the work completed has been verified and handed over. To develop the response further, the candidate could have ensured to also handover the test record sheet to the supervisor, which would ensure all reporting procedures were fully followed.

The candidate has demonstrated a basic understanding for the process of handing over documentation and adhered to the requirements of the task. To develop the response further they could have provided a more detailed account of the outstanding issues and exact dates when these should be looked at again, prior to the next scheduled maintenance activity taking place.

4. Practical observation form – handover meeting

Assessment ID	**Qualification number**
8712-313	8712-33
Candidate name	**Candidate number**
Candidate A	CG12345
Centre name	**Assessment theme**
City & Guilds	Reviewing and reporting

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

Task	**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.*
Handover	The candidate verbally described the work that they had undertaken during the maintenance activity. They described the issues encountered during fault finding and how these faults were rectified. They stated how testing showed that the system was now producing the correct type of current (DC) but the voltage was slightly lower than the expected 5 V, so additional checks should be carried out to investigate this further, recommending reactive maintenance is completed by 10/04. The candidate outlined the key points where they changed their method statement and gave a brief account of why this was necessary. The candidate provided a brief functional walk through of the system in operation. This however contained limited reference to the test results and the outputs being provided by each block of system circuitry. Technical terminology was used but was limited. The candidate described where changes were made to the maintenance schedule as a result of the peer review feedback. They described that one peer recommended additional testing within the planned maintenance activities going forward, but they did not think this was necessary as the system is fully tested already. Further reducing of the intervals from 6 months to 3 months was also recommended but also decided this was unnecessary and costly. The candidate provided copies of some key documents including the maintenance log, controlling of documentation log and updated maintenance schedule. The candidate did not describe these documents in detail, simply providing a superficial overview of the main points, but ensured to obtain a signature. The candidate demonstrated good communication using some technical terminology appropriate to the audience, but mostly using language more appropriate for a non-technical audience, rather than a subject matter expert that they were communicating with. Overall, the handover was adequate, but could have benefited from more attention to detail and thorough explanation when talking about the documents and potential future issues with the system.

Assessor signature	**Date**
Assessor.1	04/04/2022

Commentary

The observation record details that the candidate undertook an adequate handover that reflected the key information to be handed over. For example, the candidate talked through the maintenance that had occurred, what changes they had undertaken to their original planning and with a brief account of the outcomes.

The candidate acknowledged changes made to the planned maintenance schedule with a brief description. The candidate also acknowledged suggestions from the peer review feedback that they chose to dismiss. The response could have been developed further by explaining these in more detail, for example why they believed additional testing was unnecessary for future planned maintenance.

The candidate shared some of the correct technical documentation expected in a handover but could have developed their response further by ensuring that all required documentation was correctly handed over and described in more detail. For example, the test record could have been handed over which would have supported their explanation of work carried out and future recommendations. Some appropriate use of technical and non-technical vocabulary was used, but this could have been more consistent and appropriately directed towards a technical audience.

The handover would have benefitted from being developed further in places, for example, the demonstration of the functional system was noted as being brief. The candidate could have developed their response by providing a walkthrough that provided a more detailed account of the maintenance and explaining the implications of test results on overall system functionality in more detail.