T-LEVELS | Institute for Apprenticeships & Technical Education

T Level Technical Qualification in Maintenance, Installation and Repair for Engineering and Manufacturing (8712-34)

Maintenance Engineering Technologies: Control and Instrumentation (314)

Guide standard exemplification material

Distinction – Sample

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Introduction

The sample assessment materials within this document refer to the Maintenance Engineering Technologies: Control & Instrumentation sample occupational specialism assignment. The aim of these materials is to provide centres with examples of knowledge, skills and understanding that attest to a distinction grade. 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 provide a representative example of all tasks in the sample assignment. The evidence presented here has been developed to reflect a distinction grade 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. A distinction grade will be based on a synoptic mark across all tasks.

The materials in this Guide Standard Exemplification Material (GSEM) are separated into three 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
This section includes detailed comments to demonstrate how the candidate evidence attests to the standard of distinction 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 distinction.

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 distinction, a candidate will typically be able to:

Competently and thoroughly interpret technical information, applying technical skills to plan, assess risk and follow safe working methods to practical tasks and procedures to an exemplary standard in response to the requirements of the brief, working systematically, logically and efficiently, producing an excellent quality of work that meets regulations and standards.

Thoroughly prepare working areas, mitigating potential risks prior to commencing tasks and consistently apply exemplary housekeeping techniques during tasks that allow safe and efficient working.

Demonstrate comprehensive technical skills for diagnosing components, assemblies and sub-assemblies to complete maintenance, installation, service and repair activities, in line with the requirements of the brief, working systematically, logically and efficiently.

Demonstrate exemplary technical skills using tools and equipment for control and instrumentation maintenance, installation and repair, ensuring safe isolation, removal and replacement of components, working systematically, logically and efficiently.

Demonstrate comprehensive knowledge and understanding of the principles and processes required for disassembly, repair, configuration and re-assembly of control and instrumentation systems, ensuring that all tolerances and calibrations are in-line with specification.

Work safely and make well founded and informed decisions on the selection and appropriate use of tools, materials and equipment within the working environments for maintenance, installation and repair activities.

Consistently and accurately use industry and technical terminology across different communication methods with full 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.

Resources
The following resources will be required to undertake the required maintenance activities.

Physical resources (tools/equipment)
The following will be needed to undertake the maintenance activities.

	Quantity	Purpose and justification
24 V supply	1	24 V supply is the supply voltage to the system to energise the process; using any other voltage would present a risk to damaging the system or to the safety of operatives.
Wireless network (Bluetooth or Wi-Fi)	1	Communication between the system and the PLC. Wireless network will enable remote accessing and controlling of the system.
Transmitter	1	Spare on hand should a replacement be required, to ensure the task can be completed without additional downtime.
Potentiometer	2	Spare on hand should a replacement be required, to ensure the task can be completed without additional downtime.
Thermocouple	1	Spare on hand should a replacement be required, to ensure the task can be completed without additional downtime.
Screwdriver (terminal)	1	Removal and assembly of components.
Screwdriver (Philips and flathead)	2	Removal and assembly of components.
Wire cutter	1	Terminating wires that may need to be replaced.
Pliers	1	Removal and replacing purposes.
Cable identification markers	6	Identify wires.
Crimping tool	1	Aid with crimping of new terminations.
Potentiometer trimmer	1	Adjusting the pot within the transmitter should any calibration be required.
Cables/leads/connectors	1	To perform calibration on the transmitter and connect the test equipment up into a loop.
Temperature bath	1	To heat the system and also to use for any calibration requirements that may be required.
Multimeter	1	Conducting electrical checks and completing any calibrations that may be required. May be used to

		check continuity of wires and ensure sound electrical connections. Can be used to aid with any fault finding and diagnosing that may be required.
Multi-function calibrator	1	To complete calibrations that may be required and checks on the system if required.
Human machine interface	1	To display the system operation and state, as well as identify any issues or unhealthy operation of the system. Will be required to obtain parameters from the system and ensure that readings being displayed are as expected.
Programmable Logic Controller	1	To programme and control the system.
Software	1	Programme to complete inputting and make modifications to the programme.
Laptop	1	Complete setting up of software and to be used for fault diagnosis purposes.
Materials and consumables *The following will be needed to undertake the maintenance activities.*		
Clean cloths and rags	6	To control any spillages or residue that may leak or be spilled from the system. Will also be used to complete the cleaning post and pre job.
Bootlace ferrel (0.5mm-1.5mm)	6	Terminating cables and ensuring sound electrical connections.
1.5mm red wire	3m	Replacing of wires if damaged or defective.
1.5mm black wire	3m	Replacing of wires if damaged or defective.
Thermocouple wire	1	Type K or J thermocouple wire in case it is found to be damaged or needing replaced due to not sensing correctly.
Protective equipment *The following PPE are required to support safety during the maintenance activities, and to meet requirements of the Health and Safety at Work Act (HASAWA).*		
Heat resistant gloves	1	To be worn when handling and removing the sensor whilst hot or still warm as well as handling the temperature bath.
Safety glasses	1	Work activities such as terminating wires can cause flying debris that may get into the eye. Protection from dust and other contamination that may result from cleaning the system before and after working activities.
Overalls	1	Basic PPE requirement for Engineering working areas and to protect clothes from dirt, water and other contaminants that may result from the process. Protection of the body from hot liquid or hot objects such as sensor.
Safety shoes/boots	1	Basic PPE requirement for Engineering areas. Limit injuries from instruments, tools and equipment causing damage to feet.
Electrostatic Discharge mat	1	Extra precaution when dealing with the removal and replacing of electronic components.
Warning signs and notices		To indicate that electrical supplies are isolated, informing others in the area.
Technical Information *The following technical information and documentation will be required to refer to during the maintenance activities to support accurate application of equipment, and to ensure the brief requirements are met.*		

Requirement	Purpose and justification
Product data sheet/manufacturers manual	For the transmitter, to access specifications and drawings to aid with calibration and setting up.
PLC and hardware manual	Guidance on the use, setting up and programming of the system. Will be used as a troubleshooting guide should any issues arise
Risk assessment	To complete before beginning the task. The risk assessment will ensure that all hazards have been identified and control measures are implemented to mitigate any risks.
Method statement	To refer to during maintenance activities to ensure logical order can be easily followed.
Assignment brief, specification and diagrams	To aid with understanding the engineering process and to refer to during task to ensure brief requirements are being accurately met.
Other key requirements The following additional requirements are areas that I need to consider in detail in order to support the safe, efficient and effective deployment of the maintenance activities	
Requirement	**Purpose and justification**
Waste disposal	Follow WEEE requirements to dispose of wiring, off cuts and faulty components.
Time needed	Prepare the work area 1 hour Decommission and inspect system 2 hours Fault finding and diagnose 2 hours Repair 90 mins Calibrate 2 hours Recommission 1 hour Recording 1 hour Re-instate work area 30 mins
Access requirements	Check location of system and need for ladder or appropriate steps, follow working at height regulations.
Fault finding/diagnostic techniques and methods	
Input to output	This particular fault-finding method could be applied to a system like this because where there is an input of temperature/power, but no output of temperature/power, a fault within the system has been identified.
Half split technique	This method will allow for the process to be broken down into sections and the functionality of each section be checked. Eventually there will be one area left, which will narrow down where the fault is.
Sensory checks	Visually inspect the system to identify any obvious issues, such as a fault being displayed on the HMI, loose wiring etc. Smell to ensure there is no burning of wires or components. Listen to the system for any unusual noises that may indicate an issue such as buzzing or rattling. Touching the system could indicate whether the process is too hot, cold or any vibration.
Unit substitution	This fault-finding method would apply to the system should any components become faulty, they can then be replaced with known working parts such as the transmitter.

Commentary

The candidate has interpreted the requirements of the brief well, creating a comprehensive list of resources that demonstrate an excellent knowledge and understanding for the maintenance process and the task requirements. The structure and presentation of the resources list is clearly broken down into specific areas reflective of the task to be undertaken.

The justifications provided for each requirement and resource listed are clear and demonstrate logical thinking and understanding of the maintenance process, for example conducting the half split technique will ensure the process can be broken down and checked section by section, narrowing down where there are any faults and the causes of them.

The candidate has identified the amounts of each resource and piece of equipment correctly, in some cases obtaining more spares than may necessarily be required, showing how the candidate has pre-empted any issues and planned efficiently for different scenarios to reduce system downtime.

The candidate has gathered and analysed appropriate technical information and listed the relevant documentation to be obtained and completed, justifying the application of the documents and their relevance to the task to meet the requirements of the brief. They have interpreted the technical information and identified effective fault-finding methods to be used to complete the task and investigate the system to correctly diagnose faults and inform the appropriate resolution methods.

Individual components that make up the system have been identified and considered, as well as the tools and equipment that would be required to install, remove, repair and replace, ensuring activities can be completed efficiently. The justifications provided are detailed, allowing the candidate's knowledge, and understanding of the process to be showcased.

The candidate has accurately listed all appropriate elements of PPE required for the task, demonstrated exemplary understanding of safe working practices and of the Health and Safety at Work Act, which have been used to inform the planning for the tasks to be undertaken.

1b. Risk assessment

Preparation				
Hazard	Risk	Control	Likelihood	Severity
Working area when undertaking pre-preparation checks	Slips, trips and falls, personal injury.	Analyse working area before entering. Ensure no equipment or tools are on the floor and that walkways are clear.	2	1
Manual handling of tools and equipment needed for maintenance	Personal injury from items dropping, back injury from lifting.	When obtaining equipment and tools ensure awareness of maximum lifting weight. Check the size and weight of equipment and the load to be moved before moving. Consider lifting position and posture, and whether support is needed from others to safely move the equipment/load. Prior to moving any equipment or load, check that the area around the temperature control system and where the equipment is being moved to is clear and free from any obstructions. Ensure correct training has been provided.	2	1
Preparation of hand tools and equipment for the maintenance activity	Cuts, abrasions, general hand injury.	Take care when selecting and organising tools and equipment. Check the condition of tools before obtaining them. Follow PUWER regulations.	2	1

Maintenance				
Hazard	Risk	Control	Likelihood	Severity
Cleanliness and safety of the working area throughout the maintenance activity	Slips, trips and falls, personal injury.	Ensure no equipment or tools are on the floor and that walkways are clear. Ensure area is clean and tidy throughout preparation, maintenance and upon completion. Store removed parts and components appropriately.	2	1
Manual handling or movement of heavy and bulky equipment or removal of parts of the system when undertaking maintenance	Personal injury from items dropping, back injury from lifting.	Check weight of tools, equipment or system components before attempting to lift to ensure not to lift over maximum lifting limit. Ensure correct training has been received.	1	1
Working with electricity within a live system	Electrocution	Ensure safe isolation is carried out, ensuring that electrical supplies are locked off where possible, following IET regulations. Use voltage tester and proving unit to ensure that there is no power coming into the system.	3	2
Stored energy (temperature) when handling and removing components such as the sensor, and handling the temperature bath	Burns, scalding, injury.	Ensure that correct procedures are followed when working on the system once it is heating up and powered on. Wear heat resistant gloves when handling components such as the sensor that have been subject to high temperatures. Ensure system and all components have cooled down before removing and replacing parts.	2	1
Use of hand tools and equipment when undertaking maintenance, such as removing, replacing and terminating wires	Cuts, abrasions, general hand injuries.	Ensure correct selection and use of tools for the activity. Ensure proper use of tools and equipment, particularly wire cutters and crimpers. Ensure correct PPE is obtained and worn, such as gloves when working with hot components and safety glasses to protect from flying debris e.g. when snipping wires. Ensure sufficiently trained in the use of hand tools and electrical test equipment. Follow PUWER regulations.	2	1
Spilt liquid that may occur, such as residue spilled from the system during maintenance	Slipping	Monitor the temperature control system during maintenance and check if any residue is noted as leaking, or if any spillages are seen. If a spillage is to occur ensure correct procedures are followed to clean up, using cloths and rags. Follow MSDS.	3	4

Fault finding				
Hazard	Risk	Control	Likelihood	Severity
Cleanliness and safety of the working area whilst fault finding	Slips, trips and falls, personal injury.	Ensure no equipment or tools are on the floor and that walkways are clear. Ensure area is clean and tidy throughout preparation, maintenance and upon completion. Store removed parts and components appropriately.	2	1
Manual handling	Back injury.	Check weight of tools and equipment before lifting to ensure not to lift over maximum lifting limit. Ensure correct training has been received.	1	1
Undertaking fault finding activities on a system with live electricity	Electrocution	Ensure safe isolation is carried out, with electrical supplies locked off where possible, following IET regulations. Use voltage tester and proving unit to ensure that there is no power coming into the system. Ensure that the system is fully secured with panels reinstated and locked prior to re-energising.	3	2
Equipment malfunction/faulty components whilst investigating the live system	System heating up when working on it	Isolate/power off the temperature control system before removing and replacing components and equipment.	2	1
Use of hand tools and equipment whilst undertaking fault finding and to support any remedial action to the system	Cuts, abrasions, general hand injury.	Ensure correct selection and use of tools for the activity. Ensure proper use of tools and equipment, particularly wire cutters and crimpers. Ensure correct PPE is obtained and worn, such as gloves when working with hot components and safety glasses to protect from flying debris e.g. when snipping wires. Ensure sufficiently trained in the use of hand tools and electrical test equipment. Follow PUWER regulations.	3	2
Stored energy (high temperature) whilst fault finding and on reinstatement of the system	Burns, scalding, injury.	Wear heat resistant gloves when handling components subject to high temperatures. Ensure the temperature control system and components have cooled down before removing and replacing parts.	2	1
Spilt liquid from the system	Slipping	If a spillage is to occur ensure correct procedures are followed to clean up, using cloths and rags.	3	4

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 structured the risk assessment logically by considering each of the key maintenance activities individually. In doing so they have shown understanding of the different hazards that can occur at each stage of the maintenance process.

The candidate has thoroughly considered and identified a comprehensive range of hazards and risks associated with the different stages of the maintenance activities on the system to ensure safe working is followed. They have categorised each element of the activities and identified each hazard for each element, showing a thorough understanding and awareness of health and safety working practices to ensure the safety of themselves and others. The candidate has accurately labelled the likelihood and severity for each risk and hazard, anticipating that most of the hazards stated are low due to the nature of the system.

Control measures are detailed, and the candidate has considered a wide variety of scenarios and situations that may arise, demonstrating thorough knowledge and understanding for the process and the activities to be completed. For example, checking the condition of tools and equipment prior to use. This demonstrates understanding of the hierarchy of control. The candidate displays extensive knowledge for risk mitigation techniques for the task, describing clearly how the PPE will aid with personal protection.

1c. Method statement

Maintenance

Initial pre-maintenance checks

Firstly, I will obtain the PPE (gloves, safety glasses, boots and overalls) checking it over to ensure that there is no damage and it is fit for purpose. Should the PPE not be fit for purpose or found to be damaged, this will be reported to the appropriate people. Once checked and wearing the PPE the working area can be entered.

Once the work area has been entered, I will visually check the area initially to ensure the area is clean, safe and tidy. Remove any objects, equipment or tools that may be on the floor to mitigate the chance of slips, trips and falls, then put signage in place indicating work is being carried out.

All of the above will be in compliance with both the PPE regulations (Personal Protective Equipment at work Regulations 1992) and the HASWA (Health and Safety at work act 1974).

Undertaking the maintenance activity

The first thing I will do is visually inspect the system and function check the system to ensure that it is in operational condition and a healthy state. I will look at the HMI to ensure the system is running as it should and that there is an output being received. I will check the HMI for any faults that may be indicated and ensure there are no issues with the wireless network. If any faults should arise, I will apply the appropriate fault-finding techniques to investigate and diagnose any potential causes. I will conduct any testing that may be required and remove and replace any equipment and components that may be faulty. Once the fault has been rectified, I will commence with the maintenance activity.

If there are no faults, I will proceed to clean down the system as part of maintenance to prevent any settled dust or debris from getting into the system when the sub-assemblies are removed. Once I am happy the system is cleaned, I will remove any sub-assemblies to gain access to the components. I will visually inspect the components and wiring of the transmitter to ensure all connections are electrically sound and that no damage or wear and tear is visible.

Once I am satisfied following the IET guidance note 2 for ELV (extra low voltage) I will lock off the supply with a tag out device (LOTO), remove the fuses and isolate the system following safe isolation procedures. I will lock off the supply to ensure it cannot be re-energised whilst I am working on it. System should then be tested for dead with an approved voltage indicator and proving unit following the prove-test-prove method. Although it is deemed low voltage, there is a still a potential for a shocks or damage to the system and components.

I will then remove the transmitter from the thermocouple and perform calibration which is required as part of the maintenance. For the calibration I will be using a power supply, a multifunction calibrator to simulate the temperature, the transmitter and a multimeter.

I will apply full scale temperature before applying 0 degrees Celsius, then work up the scale in intervals.

I will accurately record the results of the calibration and calculate to ensure that the readings are within tolerance, before disassembling the loop and reinstalling the transmitter to the system. Accurately recording all test and calibration results ensures there is a clear paper trail of the work done, any issues found and how well the system is now operating. This will be needed for further maintenance and are a record for legal purposes.

Once I am happy that it is wired back in correctly, I will reassemble the system and conduct visual inspections to ensure that the system is visually ok and panels are secure before removing the lock and supplying power back to the system. I will then function check the system and ensure the process is operating correctly.

Post maintenance

Once I am satisfied that the maintenance has been completed, I will tidy up my area and ensure that all tools and equipment are free from damage before returning to dedicated storage. I will clean my area and dispose of waste correctly, ensuring any disposal and regulatory requirements such as WEEE are followed. I will then handover the system to the assessor, demonstrating the system functionality and condition as part of the handover agreement. I will complete any necessary paperwork and amend any documentation that may need amending, before handing this over to the assessor.

Commentary

The candidate has set out a detailed method statement, demonstrating logical thinking and planning. The way the method statement is set out provides a comprehensive guide for the candidate to follow to complete the maintenance activities. Steps are detailed without stages assumed and would allow the process to be easily followed correctly by a third party. For example, the detail provided relating to the specific steps needed to correctly remove and replace the transmitter.

The candidate has considered and referred to a range of regulatory requirements showing their knowledge and understanding of compliance with workplace practices, such as checking the condition of tools, equipment and PPE before beginning the task. The candidate has used relevant and accurate technical terminology throughout their method statement. They have demonstrated understanding of the different elements of the system, processes and regulations that impact the work undertaken.

The candidate has provided detailed justifications most of for their proposed actions, showing the candidates depth of knowledge and understanding which supports thorough planning and preparation skills for the maintenance activities to meet the requirements of the brief. For example, explaining why it is important that all test results are accurately recorded.

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:

- calibration results
- 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 disassembly - Illustrated in Task 2 photographic evidence section below (photograph 2)

- Photographic evidence showing test set up for calibration – illustrated in Task 2 photographic evidence section below (photographs 3 and 4)

- Photographic evidence showing the top of the thermocouple to show the wiring of the replaced transmitter, including connections - Illustrated in Task 2 photographic evidence section below (photographs 5, 6 and 7)

- Photographic evidence showing the re-instated work area – Illustrated in Task 2 photographic evidence section below (photograph 8)

Candidate evidence

2. Calibration results

Temperature transmitter

Calibration certificate

Serial Number – X3456	**Unit –** °F/°C	**Transmitter range** – 0-600
Full scale value - 600°C	**Tolerance –** 1.0 %±	**PASS/FAIL -** Pass

AS FOUND RESULTS

Applied temperature	Achieved temperature	Error	In tolerance? (Y/N)
0 °C	1.6 °C	+ 0.6 °C	N
150 °C	156.0 °C	+ 6.0 °C	N
300 °C	304.1 °C	+ 4.1 °C	N
450 °C	456.7 °C	+ 5.7 °C	N
600 °C	609.3 °C	+ 9.3 °C	Y

CALIBRATED RESULTS

Applied temperature	Achieved temperature	Error	In tolerance? (Y/N)
0 °C	0.1 °C	+ 0.1 °C	Y
150 °C	150.5 °C	+ 0.5 °C	Y
300 °C	300.7 °C	+ 0.7 °C	Y
450 °C	451.2 °C	+ 1.2 °C	Y
600 °C	602.5 °C	+ 2.4 °C	Y

This calibration record certifies that this temperature transmitter has been calibrated to the required standards.

Print name and signature: Candidate.B	**Date:** 03/04/2021
Secondary name and signature:	**Date:**

Commentary

The candidate completed the calibration certificate with some minor calculus errors although the documentation is valid and complete, showing the candidate understands the calibration and recording process.

The candidate has calculated the tolerances with some minor calculation errors, demonstrating application of mathematic skills and ability to follow maintenance procedures. The candidate has completed the information required correctly at the top of the sheet and has signed the sheet to clearly indicate that the task has been completed.

2. Completed test record

Test record sheet – 03/04/2021

Test set up
The temperature transmitter was removed as part of the maintenance and calibrated. During testing the transmitter was out of calibration and could not be trimmed within specified tolerance, therefore it was obvious that the transmitter had failed and needed replacing. Once replaced, the transmitter was then calibrated using a multifunction calibrator and a multimeter. Once the transmitter was within tolerances the calibration was deemed complete and reinstalled to the system.

Testing of the system
The transmitter was wired back into the thermocouple and the system re-energised to test and the thermocouple placed into a temperature bath. The temperature bath was upscaled and the readings compared on the HMI.

Input temperature	HMI indication
0 °C	0.1 °C
150 °C	150.5 °C
300 °C	300.7 °C
450 °C	451.2 °C
600 °C	602.5 °C

The HMI readings reflects the obtained readings during the calibration, so this proves that the HMI is receiving accurate temperature readings from the system and displaying them correctly.
The next thing to test was the set points and ensure the temperature low and high was being detected and displayed on the HMI.
Once the set points were confirmed, I was happy that the testing of the system was now complete. The maintenance could then be completed.

HMI connectivity fault
The fault diagnostic technique most appropriate for the system and the issues that were identified is the six-point technique. The first step was to gather evidence, which was the ‘offline’ status displayed on the HMI. Next was to analyse the offline status, and upon closer inspection, it was noted that there were no readings displayed from the system which indicated that there was potentially no network connectivity. This enabled the fault to be located to the Wi-Fi connection. The next step in the fault-finding method used is to determine and remove the fault, which was completed by connecting the Wi-Fi, which led

to the rectification of the fault. The final part was to test the system which confirmed the connectivity to be restored and the offline status to clear. There were still no readings however which led onto the application of the half split technique, which narrowed down the process into parts to help identify the disconnected wire from the temperature transmitter.

When checking the PLC program, all inputs were checked, and the ladder diagram checked. This was when the sensor was noted to be inputted wrong and was a temperature switch rather than a temperature sensor.

Commentary

The candidate has completed a comprehensive test record and clear detail of the steps taken to set up and complete the testing process, including a comparison of input temperature versus HMI displayed temperature. All information recorded is clear and detailed. The candidate explored and used a wide range of testing techniques to measure the function of each sub-assembly before and after repairs, as well as the system as a whole. This demonstrated a comprehensive understanding and application of testing methods from the scope of options available.

The candidate has described a logical approach to the fault finding and the maintenance by restoring the overall connectivity to the system. This demonstrates the candidate's knowledge and understanding for the process and how the process is expected to operate.

2. Updated maintenance records and control documents

Maintenance log							
			System type:	Temperature system			
			System TAG number:	1A2B3C			
			Department responsible for equipment:	Maintenance engineering department			
Date:	**Maintenance performed by:**	**Maintenance description:**	**Work completed outside the scope of planned maintenance:**	**Are any problems identified rectified? Y/N**	**Validation performed by:**	**Next maintenance due date:**	**Comments:**
03/04/2021	Candidate.B	Scheduled maintenance and temperature transmitter calibration.	Yes, the system was indicated offline, after investigation it was found that the Wi-Fi was not connected so was rectified, before locating a disconnected wire from the transmitter. PLC program also checked and rectified, as well as replacement of the temperature transmitter due to inability to bring into specification.	Y		03/04/2022	The job has been completed however it is advised the maintenance schedule is revisited. More regular maintenance will ensure sources of potential faults can be identified earlier and before they become a problem for the operation.

Controlling of documentation and software log					
Date:	**Checking of documentation performed by:**	**Is the software and versions up to date?**	**Are there any issues with the PLC?**	**Are risk assessments in date and applicable to the task?**	**Any issues with diagrams and specifications to report:**
03/04/2021	Candidate.B	Yes, most up to date software is being used. V2.1	No issues. PLC all OK and software correct for the PLC.	Yes. Area risk assessment has been checked and is in date. Risk assessment produced in task 1 is for the working activity.	All documents are complete, valid and in date. Should any problems have been found this would be relayed to supervisor who would then contact the document controllers as per chain of command.

Commentary

The candidate has completed the maintenance log accurately, noting the four faults that were found outside of the planned routine maintenance, the actions needed to repair them and that testing confirmed these were fully rectified. The candidate has demonstrated an awareness of the need to revisit the maintenance schedule in order to support future preventative action.

The candidate has completed the control documentation accurately and with clear and relevant detail, including software version number currently in use, demonstrating comprehensive understanding of the purpose of control documentation being used over time.

The maintenance log and control documentation are presented well, all areas are complete and valid. The candidate has commented on the checking of dates, describing the steps to be taken had there have been any discrepancies or issues found, which allows for the candidate's knowledge of correct processes and procedures to be demonstrated.

2. Annotated method statement

Maintenance

Initial pre-maintenance checks

Firstly, I will obtain the PPE (gloves, safety glasses, boots and overalls) checking it over to ensure that there is no damage and it is fit for purpose. Should the PPE not be fit for purpose or found to be damaged, this will be reported to the appropriate people. Once checked and wearing the PPE the working area can be entered.

Once the work area has been entered, I will visually check the area initially to ensure the area is clean, safe and tidy. Remove any objects, equipment or tools that may be on the floor to mitigate the chance of slips, trips and falls, then put signage in place indicating work is being carried out.

All of the above will be in compliance with both the PPE regulations (Personal Protective Equipment at work Regulations 1992) and the HASWA (Health and Safety at work act 1974).

Undertaking the maintenance activity

The first thing I will do is visually inspect the system and function check the system to ensure that it is in operational condition and a healthy state. I will look at the HMI to ensure the system is running as it should and that there is an output being received. I will check the HMI for system condition that may be indicated and ensure there is no issues with the wireless network.

***Approach to fault finding**: Upon checking the system I found the HMI to be indicating that the system was offline. I ran a network check to ensure the Wi-Fi was connected and it was confirmed to be offline. I then further investigated the system and upon checking the temperature sensor I realised that there was a disconnected wire from the transmitter to the thermocouple head. Before spending time on the calibration, I decided to rewire the transmitter to ensure that the transmitter was in fact functioning correctly, which it was. Once this was confirmed I could continue with the maintenance and the calibration of the transmitter.*

I will proceed to clean down the system as part of maintenance to prevent any settled dust or debris from getting into the system when the sub-assemblies are removed. Once I am happy the system is cleaned, I will remove any sub-assemblies to gain access to the components. I will visually inspect the components and wiring of the transmitter to ensure all connections are electrically sound and that no damage or wear and tear is visible.

Once I am satisfied following the IET guidance note 2 for ELV (extra low voltage) I will lock off the supply with a tag out device (LOTO), remove the fuses and isolate the system following safe isolation procedures. I will lock off the supply to ensure it cannot be re-energised whilst I am working on it. System should then be tested for dead with an approved voltage indicator and proving unit following the prove-test-prove method. Although it is deemed low voltage, there is a still a potential for a shocks or damage to the system and components.

I will then remove the transmitter from the thermocouple and perform calibration which is required as part of the maintenance. For the calibration I will be using a power supply, a multifunction calibrator to simulate the temperature, the transmitter and a multimeter.

I will apply full scale temperature before applying 0 degrees Celsius, then work up the scale in intervals.

I will accurately record the results of the calibration and calculate to ensure that the readings are within tolerance, before disassembling the loop and reinstalling the transmitter to the system. Accurately recording all test and calibration results ensures there is a clear paper trail of the work done, any issues found and how well the system is now operating. This will be needed for further maintenance and are a record for legal purposes.

Once I am happy that it is wired back in correctly, I will reassemble the system and conduct visual inspections to ensure that the system is visually OK and panels are secure before removing the lock and supplying power back to the system. I will then function check the system and ensure the process is operating correctly.

Post maintenance

Once I am satisfied that the maintenance has been completed, I will tidy up my area and ensure that all tools and equipment are free from damage before returning to dedicated storage. I will clean my area and dispose of waste correctly, ensuring any disposal and regulatory requirements such as WEEE are followed. I will then handover the system to the assessor, demonstrating the system functionality and condition as part of the handover agreement. I will complete any necessary paperwork and amend any documentation that may need amended, before handing this over to the supervisor.

Commentary

The candidate has clearly annotated their method statement when the scope of work needed to change from the planned method statement. This shows the candidate's ability to recognise where changes needed to be made to the planned maintenance and to react appropriately to unplanned situations encountered. For example, discovering a disconnected wire from the transmitter to the thermocouple which was originally reported as needed investigation to find this fault. The level of detail provided in the annotation also demonstrates comprehensive understanding of recording procedures, ensuring accuracy and quality of documentation.

The candidate has shown understanding of how both visual checks and measurement-based testing can result in discovery of unexpected issues and has shown how their planning has changed as a result. The candidate has demonstrated logical thinking by ensuring the transmitter was in fact working before spending time calibrating a potentially faulty transmitter. This demonstrates the candidate’s efficiency and a logical approach to their work.

2. Practical observation form – work area preparation

Assessment ID	Qualification number
8712-314	8712-34
Candidate name	**Candidate number**
Candidate B	CG23456
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 resource list and checked each piece for condition, test dates, calibration dates and that each was still accurately calibrated. They were placed in their working area within reach and methodical order of use. Technical information, including risk assessment, clean cloths and rags, and waste bins placed within the working area with consideration of slips, trips and fall hazards. Visual inspection of working area and PPE, moving an obstruction out of the walkway. Appropriate warning signs and barriers used.

Assessor signature	Date
Assessor.1	02/04/2021

Commentary

The candidate prepared the working area with all listed resources from Task 1, with all tools and equipment checked for condition, calibration dates and accuracy of calibration. This demonstrates a comprehensive understanding of how important the preparatory checks are to ensure efficient and accurate maintenance can be carried out, mitigating issues arising if an incorrectly calibrated temperature bath was used for example.

Resources were placed in the working area with consideration of the prepared method statement and steps to be followed. This demonstrates exemplary understanding of work area preparation and how this can ensure safe and efficient working throughout.

2. Practical observation form – maintenance activities

Assessment ID	**Qualification number**
8712-314	8712-34
Candidate name	**Candidate number**
Candidate.B	CG23456
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 disassembled the system correctly and carefully, checking their method statement and technical information as appropriate. The candidate completed thorough visual and physical inspections and checked the HMI. A 20-minute cool down period was observed which was appropriate for the system. Correct sub-assemblies and components were removed, with wires disconnected and placed into organised containers.
Fault detection and diagnosis	The candidate approached the fault finding logically, checking the HMI first to gain any information displayed before moving onto other areas of the system. Accurately identified potential causes before effectively diagnosing a disconnected wire within the temperature probe. Failed transmitter potentiometer diagnosed during calibration. Laptop used to check PLC program, running a simulation which identified a sensor incorrectly selected.
Resolution and calibration	Using the fault diagnosis information, candidate approached fault resolution logically, addressing the network connectivity first, then replacing wires to the open circuit, removed and replaced the failed transmitter potentiometer and lastly reprogramming the PLC. The candidate obtained and set up the test equipment for the calibration correctly with no problems and was able to complete the calibration

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.*
	certificate thoroughly. The candidate was able to accurately calculate the tolerances and complete the paperwork correctly, upon completion disconnected the test loop and returned all equipment to the correct locations.
Reassembly and recommissioning	The candidate wired up the temperature transmitter back to the thermocouple correctly and accurately, but used slightly more wire than needed, creating additional waste. Terminations had no exposed copper, wire stripped correctly and neatly, insulation had no damage. The candidate checked the connections to ensure that they were electrically sound and ensured that everything was replaced correctly. The candidate then re-energised the system and completed the necessary checks to ensure that operational condition had been achieved.
Working area	Worked safely and neatly throughout all activities, following all workshop and health and safety requirements. Disconnected wires and components placed into organised containers which mitigated any trip hazards, kept them tidy and prepared for appropriate waste disposal. All tools and equipment cleaned and returned to correct storage, waste disposed of in correct separate bins and working area left safe, clean and tidy.

Assessor signature	Date
Assessor.1	03/04/2021

Commentary

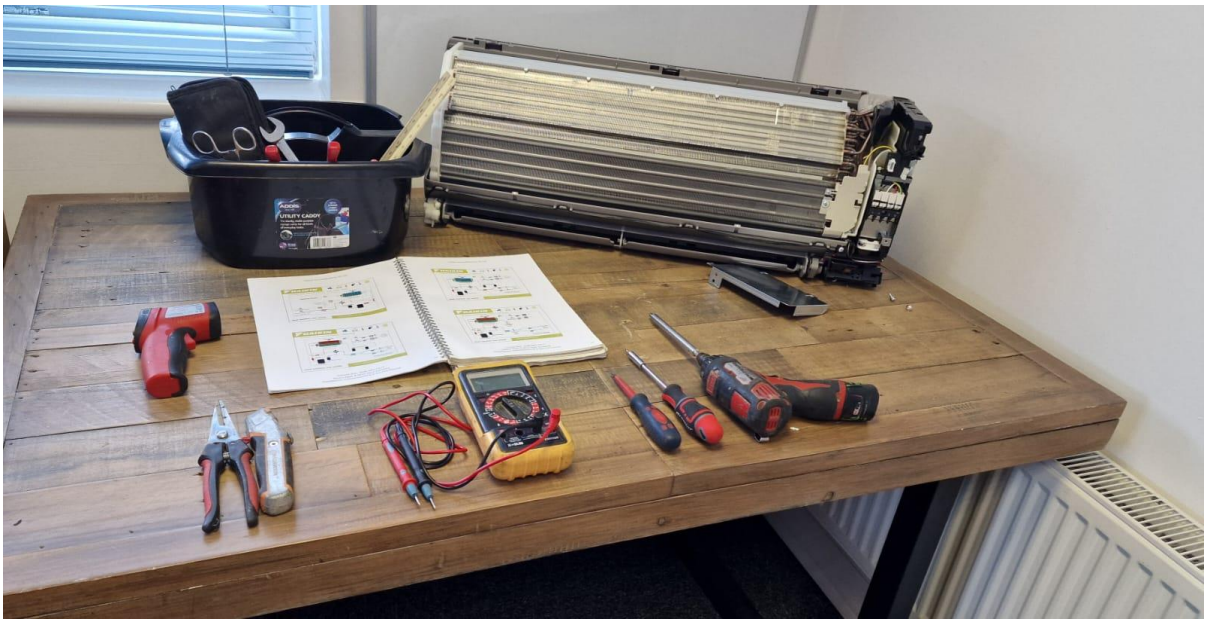
The candidate demonstrated their ability to interpret requirements and perform maintenance and fault-finding tasks in line with the requirements of the brief in a logical and methodical way. For example, addressing that the HMI indicated a network connectivity fault first in order to gain any further fault detection information. The candidate correctly and accurately diagnosed and resolved all four faults within the system.

The candidate was able to demonstrate maintenance techniques showing excellent hand skills and correct use of tools and equipment, ensuring the maintenance was completed to a very good standard. For example, test equipment set up for calibration correctly on the first attempt.

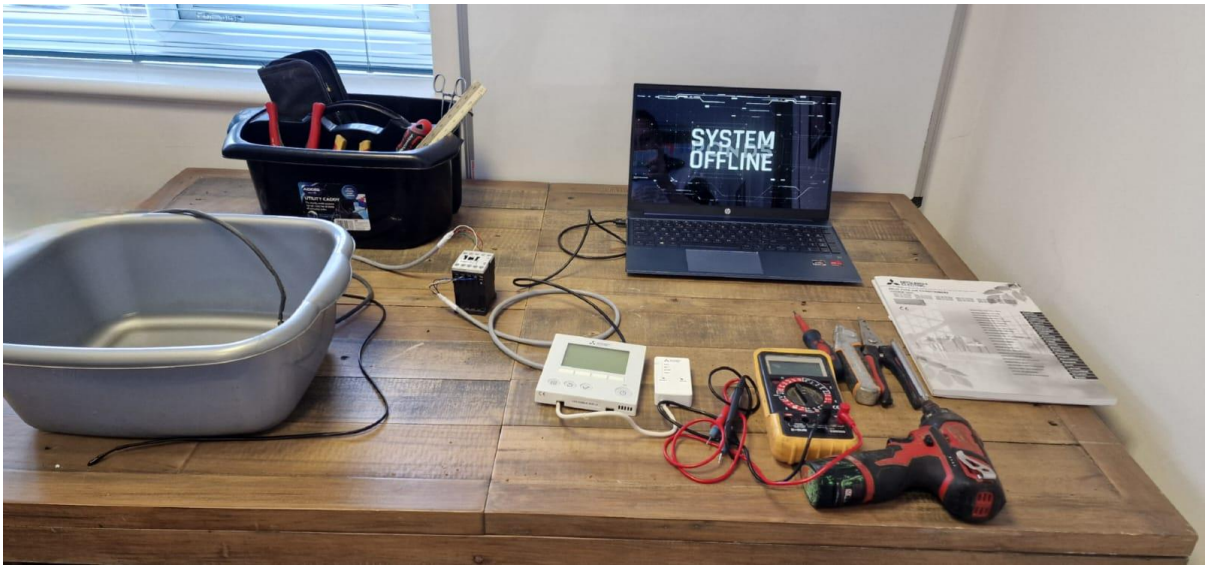
The candidate demonstrated efficient use and application of test equipment to complete the calibration correctly, demonstrating ability to interpret the calibration requirements and documentation which resulted in system accuracy.

2. Photographic evidence

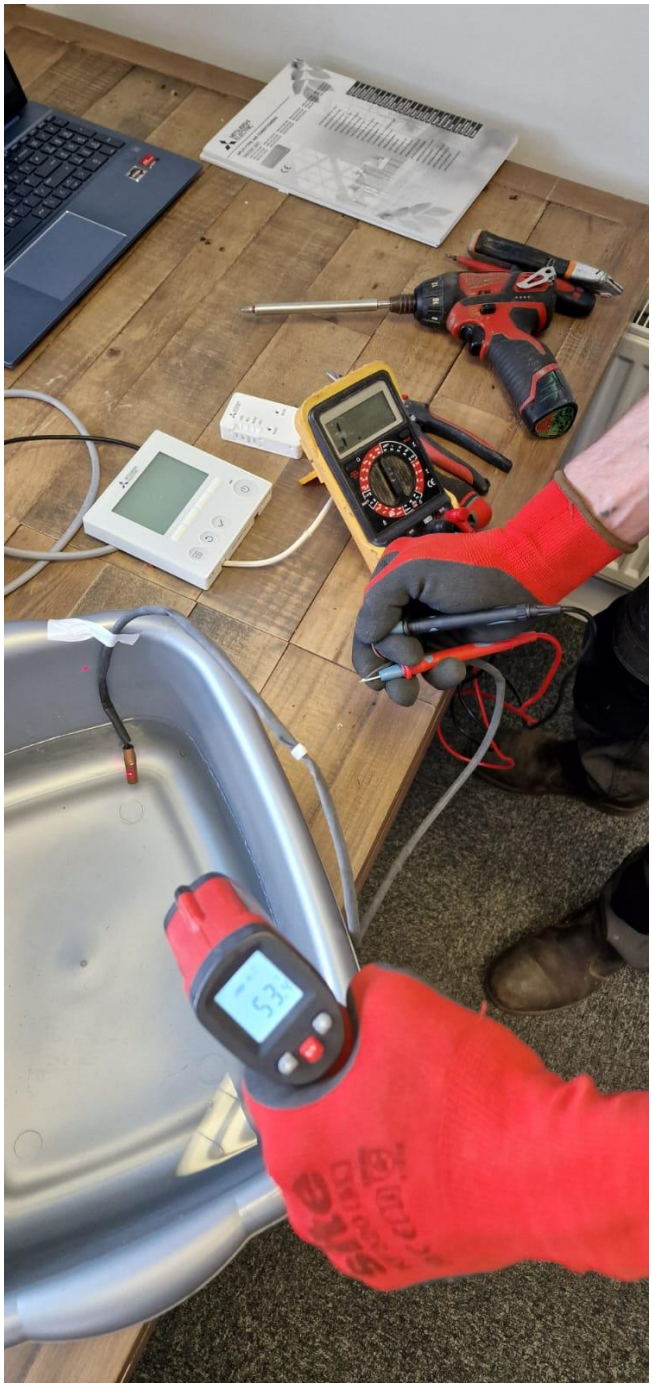
Photograph 1: Photographic evidence shows the tools, equipment and technical documentation neatly placed in their working area within reach and methodical order of use in the prepared working area.

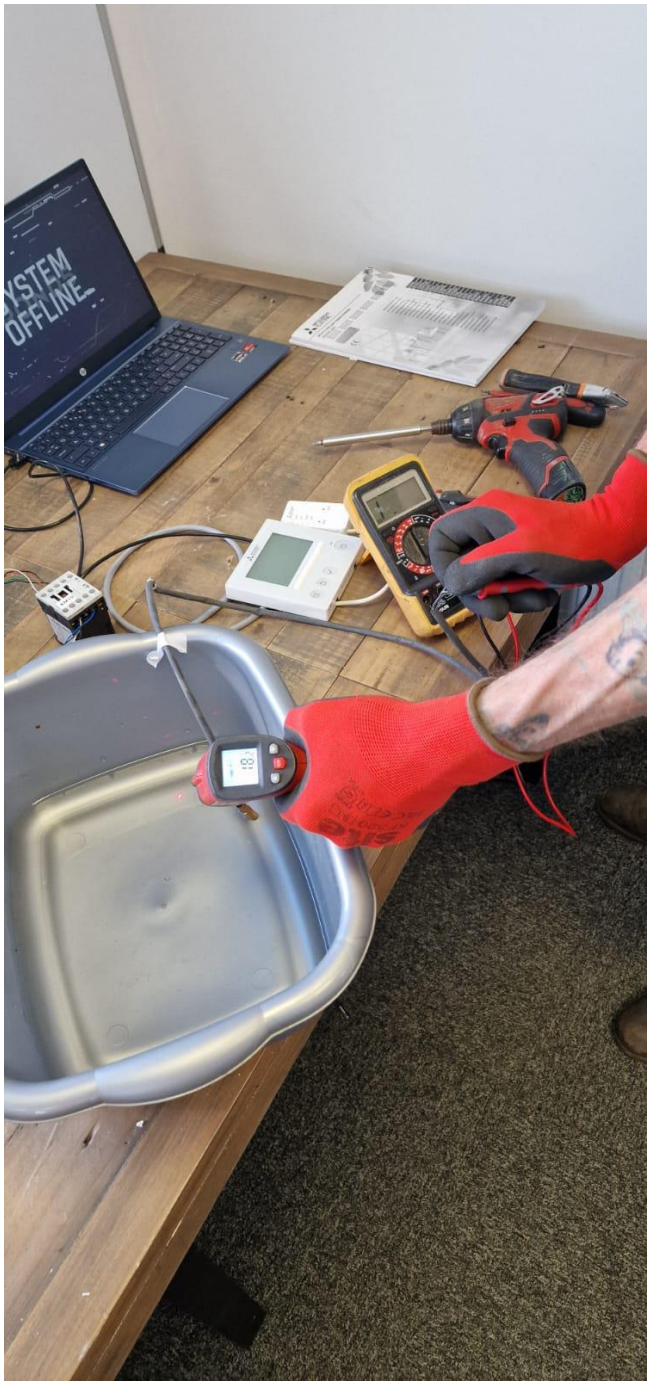


Photograph 2: Photographic evidence shows the working area after disassembly, components and sub-assemblies neatly placed in containers and out of reach of the immediate working area.

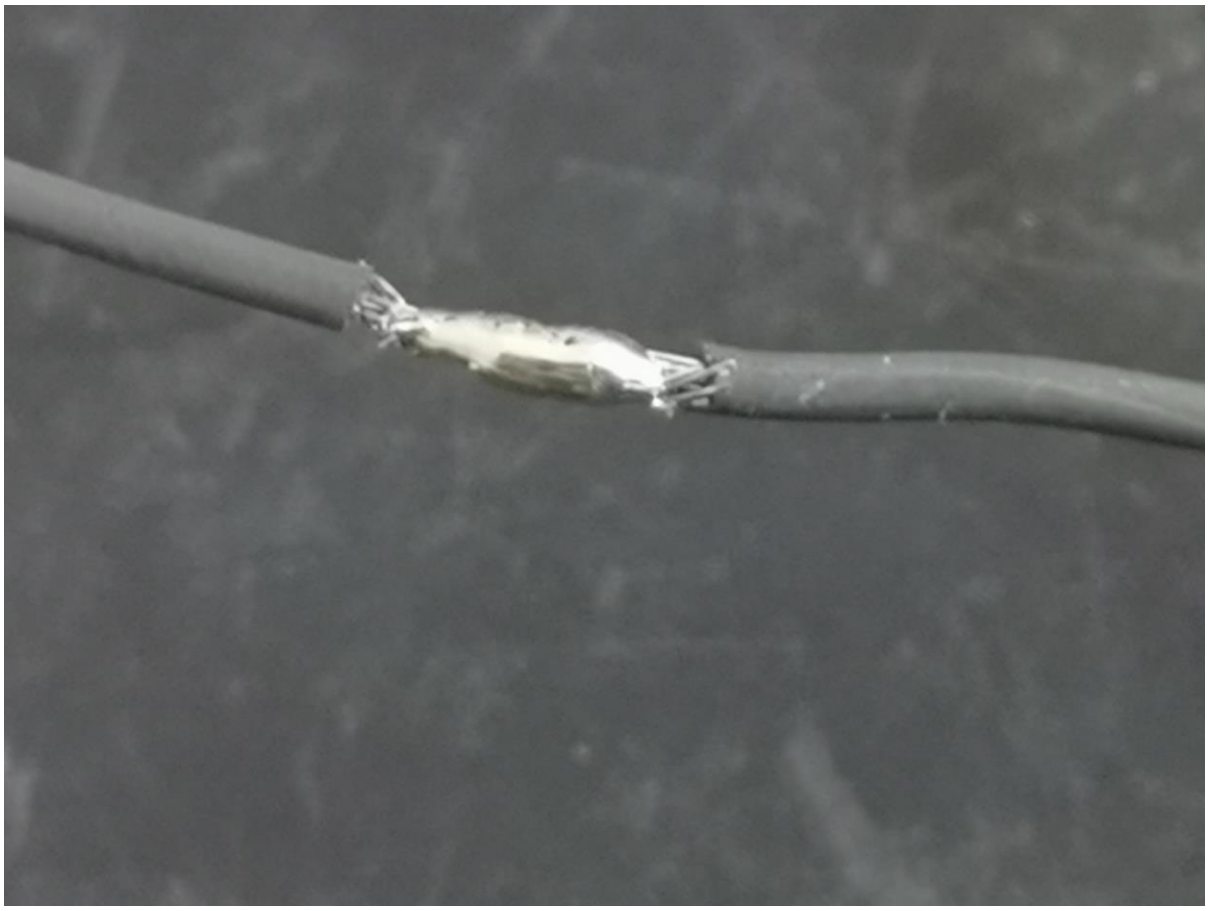


Photographs 3 and 4: Photographic evidence shows the test set up for the calibration including displays of test equipment showing the simulated temperature and the values obtained.





Photographs 5, 6 and 7: Photographic evidence showing the thermocouple head with the transmitter wired back in. The photographs clearly show the condition and quality of the wiring, reflecting the correctly selected and fitted crimps. The length of wire is appropriate, but slightly more is used than would have been needed. The terminations show no exposed copper, with wire stripped correctly and neatly. Insulation shows no damage.



Photograph 8: Photographic evidence shows the re-instated working area including the system showing overall condition and operational state and working area thoroughly cleaned and free from tools and equipment.

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

Temperature system technical report	04/04/2021

The scheduled maintenance of the temperature system has been fully completed. The maintenance included the inspecting, calibrating, and testing of the system. The inspection techniques completed include sensory checks including visual and movement checks, diagnostic tests, network and connectivity checks and finally operational and functional checks of each element of the process. The maintenance completed is fully relevant to the system and allows all the aspects of the process to be inspected and maintained, however it is to be recommended that the maintenance is conducted on a more regular basis as the issues that were found may not have occurred if the length of time during the scheduled maintenance was not as long, in effect reducing downtime.

During the scheduled maintenance, four faults were discovered, investigated, diagnosed and rectified. The fault-finding method initially used for the process was the six-point technique. This was selected because of the many different components and equipment that make up the system. Once the HMI connectivity issue had been rectified by restoring the Wi-Fi connection, the next fault of no readings on the HMI was investigated using the input output method, by investigating where the temperature is inputted and noting that there was not an output on the HMI. This showed that no temperatures were being transmitted to the HMI. This could then be investigated, and the disconnected wire was found.

Connecting the transmitter and function testing the system prior to the calibration proved the transmitter to be working, which saved time as there could have been a potential that a faulty transmitter was being calibrated. Upon calibrating the transmitter, the tolerances could not be achieved, identifying a faulty potentiometer. Replacing the potentiometer would have been time consuming so as there was a spare transmitter already selected as part of task preparation, the transmitter was just replaced, and calibrated. It is therefore recommended that the overall inspection and checking of the transmitter is completed as part of the maintenance as preventative maintenance.

As the PLC program was found to be inputted incorrectly, with a temperature switch instead of sensor it is recommended that the checking of the PLC becomes a mandatory part of the maintenance. Although the issue did not affect overall working condition of the system, it could affect accuracy and efficiency. The issue was caused by human error, so it is recommended that more time is taken when inputting ladder logic and the program is checked more regularly.

After reviewing the maintenance that was completed and the issues that were come across, there are some recommendations that should be considered. As well as the maintenance schedule, which is to be discussed, two further steps should be included in the maintenance requirements. Firstly, it is recommended that the transmitter and potentiometer are inspected as part of all scheduled maintenance and is included in the maintenance instruction. Secondly, the checking of the PLC program should be another mandatory step of the maintenance and be included in the maintenance instruction. Both steps could have easily been missed and could cause potential breakdown and issues in the future.

The maintenance schedule should be revisited, as the 12-month maintenance schedule could lead to more issues needing rectified during the planned maintenance. By reducing the intervals between scheduled maintenance, issues such as drift, deterioration and wires working loose due to the vibration of the process could be reduced and prevented. This will overall reduce the cost and time that is spent fault finding on the system. This will also enable all connections, terminals, pipework and sub-assemblies to be checked and tightened more regularly with a reduced schedule, which would be a good preventative measure to further reduce downtime and potential damage of the system.

The stock used and recorded included:

- 0.25m red wire
- 0.25m black wire
- crimps
- temperature transmitter.

There was not much waste, however all cut offs of wire and the temperature transmitter were disposed of in the electrical bin in accordance with Waste Electrical and Electronic Equipment Regulations. Any extra stock that was obtained as part of preparing for the task was returned to the correct location and recorded on the stock record sheet located in the stock room. This enables stock to be tracked and replenished when certain items are running low.

Overall, the maintenance is cost effective, only requiring hours of the engineer and some minor costing of components such as replacement transmitters. Cost effectiveness in the long term can also be improved by reducing the length of time between the planned maintenance and optimal efficiency and accuracy of the system can be achieved. There are no outstanding issues left to report.

Commentary

The candidate has analysed and reviewed the maintenance and the issues that were found, providing a recommendation on how this can be improved through explaining that some issues may have been prevented had the system been inspected sooner.

The candidate has stated the fault finding methods applied and explained how these were applied to aid with the locating and diagnosing of the faults. For example, the candidate both identified and diagnosed there was no temperature output from the transmitter, using the input output fault finding technique to determine the cause of the fault. The candidate has explained clearly how the loose wire was then identified and rectified, showing a comprehensive knowledge of the maintenance and fault resolution processes.

The candidate has demonstrated a good understanding of test reports and their purpose by reviewing and analysing the actions taken, before completing the report with a conclusion and providing clear recommendations with valid justifications for future actions. For example, recommending the transmitter potentiometers are inspected as part of the planned maintenance.

3a. Revised maintenance schedule

System:	Findings during maintenance:	Recommendations to seniors:	Justification to seniors:	Recommended next planned maintenance due date:
Temperature system	Wi-Fi to be disconnected causing offline issue with the HMI. Temperature transmitter had significantly drifted and was not able to be brought into manufacturers tolerance. It was diagnosed to be a faulty potentiometer. This can be caused by environmental factors or significant temperature changes in the system. The transmitter was also found to have a disconnected wire, which can be cause by vibrations as the process is running. This indicated the system is running a lot and as part of an important process, the maintenance schedule will need addressed. Upon inspection of the PLC, the sensor was noted to be inputted incorrectly.	It is recommended that the maintenance schedule is addressed and altered from 12 monthly to 6 monthly. As the system is running a lot, and the environmental factors given the area the rig would be situated, there are problems that are arising within the system which is causing inaccuracy in the measurements of the process as well as issues such as disconnected components. Another recommendation to be reviewed is that the checking of the PLC program becomes part of the maintenance, as this was found to be inputted incorrectly.	As well as rectifying inaccuracies, this will reduce system downtime and any further issues arising further down the engineering system. This will save money as maintenance engineers will not need to spend as much time rectifying the issues that have arisen as well as preventing issues before they arise.	04/10/2021

Commentary

The revised maintenance schedule has been completed efficiently with a detailed explanation of the findings from the maintenance activities. The candidate has clearly identified and explained recommendations for the system that has been maintained to improve its maintenance schedule and reduce downtime by increasing the frequency of planned maintenance activities.

The candidate has provided a detailed justification for increasing the frequency of scheduled maintenance activities which considers the effects on potential downtime, cost of

replacement and safety. For example, completing planned maintenance on a more regular schedule will prove to be more cost-efficient by reducing system downtime and less maintenance time completing reactive maintenance.

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. Completed 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, however 6 months is still a long period of time for the nature of the system as thermal expansion factors have not been considered.*
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 which may have a cost implication, however, overall will reduce costs as the system will be functioning more accurately and downtime will be reduced.*
How can the maintenance schedule could be optimised/ improved?	*Where candidate.B has reduced from 12 monthly to 6 monthly, I feel that the maintenance should be completed on a 3 monthly system as to prevent the transmitter drifting and maintain full accuracy of the system. I would also recommend re-inputting the PLC program each time planned maintenance is carried out to ensure it is correct.*

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 documentation that is in place allows the maintenance steps to be recorded and stored efficiently and can be referenced back to during future maintenance activities. The planned maintenance activities are comprehensive and the schedule is appropriate for the tasks to be completed, however a reduced schedule should be considered to implement preventative maintenance.*
How appropriate are the recommended planned maintenance intervals and why?	*After reviewing the issues that the system presented during the maintenance, the recommended planned maintenance intervals may not be appropriate.*
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.B'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. Additional test measurements recommended but should be clearly stated which tests to carry out. Because the filter capacitor has failed, it's likely that this a common issue for this system so I would recommend replacing the filter capacitor each time planned maintenance is carried out.*

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:
Temperature system	Wi-Fi to be disconnected causing offline issue with the HMI. Temperature transmitter had significantly drifted and was not able to be brought into manufacturers tolerance. It was diagnosed to be a faulty potentiometer. This can be caused by environmental factors or significant temperature changes in the system. The transmitter was also found to have a disconnected wire, which can be cause by vibrations as the process is running. This indicated the system is running a lot and as part of an important process, the maintenance schedule will need addressed. Upon inspection of the PLC, the sensor was noted to be inputted incorrectly.	It is recommended that the maintenance schedule is addressed and altered from 12 monthly to ~~6 monthly~~ 3 monthly~~.~~ As the system is running a lot, and the environmental factors given the area the rig would be situated, there are problems that are arising within the system which is causing inaccuracy in the measurements of the process as well as issues such as disconnected components. Another recommendation to be reviewed is that the checking of the PLC program becomes part of the maintenance, as this was found to be inputted incorrectly	As well as rectifying inaccuracies, this will reduce system downtime and any further issues arising further down the engineering system. This will save money as maintenance engineers will not need to spend as much time rectifying the issues that have arisen as well as preventing issues before they arise.	04/07/2021

Justification for changes:

From the peer review feedback, it was highlighted that 6 months is still a long time for the accuracy of the transmitter to drift due to the nature of the working environment. With consideration of the feedback, it has been decided that the proposed changes to the maintenance will go from 6 monthly to 3 monthly. This will improve system efficiency and reduce breakdown costs and time that could occur. Carrying out planned maintenance on a more regular schedule will improve consistency in the maintenance process and identify smaller faults early before progressing into larger more serious and costly faults.

Commentary

The candidate has clearly amended the maintenance schedule and highlighted where the change was made for easy identification. The candidate has reviewed the date and amended it, considering the peer review feedback, which demonstrates their understanding of the system, and that prevention would be more cost efficient for this system than reactive maintenance.

The candidate has taken on board the peer review feedback and implemented changes where they agreed it was appropriate to further improve safety and reduce the possibility of downtime. The candidate has provided clear justifications for the changes made, giving detailed reasoning for their decision and recommendations.

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

Temperature transmitter

Calibration certificate

Serial Number – X3456	**Unit –** °F/°C	**Transmitter range** – 0-600
Full scale value - 600°C	**Tolerance –** 1.0 %±	**PASS/FAIL -** Pass

AS FOUND RESULTS

Applied temperature	Achieved temperature	Error	In tolerance? (Y/N)
0 °C	1.6 °C	+ 0.6 °C	N
150 °C	156.0 °C	+ 6.0 °C	N
300 °C	304.1 °C	+ 4.1 °C	N
450 °C	456.7 °C	+ 5.7 °C	N
600 °C	609.3 °C	+ 9.3 °C	Y

CALIBRATED RESULTS

Applied temperature	Achieved temperature	Error	In tolerance? (Y/N)
0 °C	0.1 °C	+ 0.1 °C	Y
150 °C	150.5 °C	+ 0.5 °C	Y
300 °C	300.7 °C	+ 0.7 °C	Y
450 °C	451.2 °C	+ 1.2 °C	Y
600 °C	602.5 °C	+ 2.4 °C	Y

This calibration record certifies that this temperature transmitter has been calibrated to the required standards

Print name and signature: *Candidate. B*	**Date:** *03/04/2021*
Secondary name and signature: *Assessor. 1*	**Date:** *04/04/2021*

Updated Maintenance Schedule				
System:	**Findings during maintenance:**	**Recommendations to seniors:**	**Justification to seniors:**	**Recommended next planned maintenance due date:**
Temperature system	Wi-Fi to be disconnected causing offline issue with the HMI. Temperature transmitter had significantly drifted and was not able to be brought into manufacturers tolerance. It was diagnosed to be a faulty potentiometer. This can be caused by environmental factors or significant temperature changes in the system. The transmitter was also found to have a disconnected wire, which can be cause by vibrations as the process is running. This indicated the system is running a lot and as part of an important process, the maintenance schedule will need addressed. Upon inspection of the PLC, the sensor was noted to be inputted incorrectly.	It is recommended that the maintenance schedule is addressed and altered from 12 monthly to ~~6 monthly~~ 3 monthly~~.~~ As the system is running a lot, and the environmental factors given the area the rig would be situated, there are problems that are arising within the system which is causing inaccuracy in the measurements of the process as well as issues such as disconnected components. Another recommendation to be reviewed is that the checking of the PLC program becomes part of the maintenance, as this was found to be inputted incorrectly	As well as rectifying inaccuracies, this will reduce system downtime and any further issues arising further down the engineering system. This will save money as maintenance engineers will not need to spend as much time rectifying the issues that have arisen as well as preventing issues before they arise.	04/07/2021
Justification for changes: From the peer review feedback, it was highlighted that 6 months is still a long time for the accuracy of the transmitter to drift due to the nature of the working environment. With consideration of the feedback, it has been decided that the proposed changes to the maintenance will go from 6 monthly to 3 monthly. This will improve system efficiency and reduce breakdown costs and time that could occur. Carrying out planned maintenance on a more regular schedule will improve consistency in the maintenance process and identify smaller faults early before progressing into larger more serious and costly faults.				

Maintenance log							
System type: **System TAG number:** **Department responsible for equipment:**				Temperature system 1A2B3C 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:**
03/04/2021	Candidate.B	Scheduled maintenance and temperature transmitter calibration.	Yes, the system was indicated offline, after investigation it was found that the Wi-Fi was not connected so was rectified, before locating a disconnected wire from the transmitter. PLC program also checked and rectified, as well as replacement of the temperature transmitter due to inability to bring into specification.	Y	*Assessor. 1*	04/07/2021	Maintenance schedule has been updated and approved by seniors, planned maintenance will now be carried out 3 monthly instead of 12 monthly.

Controlling of documentation and software log					
Date:	**Checking of documentation performed by:**	**Is the software and versions up to date?**	**Are there any issues with the PLC?**	**Are risk assessments in date and applicable to the task?**	**Any issues with diagrams and specifications to report:**
03/04/2021	Candidate.B	Yes, most up to date software is being used. V2.1	No issues. PLC all OK and software correct for the PLC.	Yes. Area risk assessment has been checked and is in date. Risk assessment produced in task 1 is for the working activity.	All documents are complete, valid and in date. Should any problems have been found this would be relayed to supervisor who would then contact the document controllers as per chain of command.

4. Practical observation form – handover meeting

Assessment ID	**Qualification number**
8712-314	8712-34
Candidate name	**Candidate number**
Candidate B	CG23456
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 accurately explained in detail the actions that were taken to complete the maintenance and thoroughly justified actions. System functionality was demonstrated clearly using the correct technical terminology for each area of the system. No error messages displayed on the HMI showing the original fault has been rectified and all outputs were reading correctly. The candidate demonstrated excellent communication skills using accurate technical terminology appropriate to the technical audience. The candidate explained the revision of the maintenance schedule, providing the supervisor with an overview of the peer feedback they received, including the difference of opinion from the two sets about the time of planned maintenance intervals. The candidate then explained the decision to amend the revised maintenance schedule. One peer was concerned about cost implications and the candidate explained they chose to dismiss this concern as in the long run as increasing the maintenance intervals and fault prevention would be less costly than reactive maintenance. They also explained their decision to not make any changes from the suggestion of re-inputting the PLC program each time planned maintenance is carried out being unnecessary due to it only being a fault due to human error so not an ongoing issue if done correctly and this would add additional unnecessary costs. The candidate ensured all the documentation had been completed correctly and asked the supervisor to confirm they were happy with the information and findings presented, signing the completed documentation.

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.*
	Overall, the handover was complete, comprehensive and used excellent communication skills.

Assessor signature	Date
Assessor.1	04/04/2021

Commentary

The observation report identifies the different areas of the handover process and how the candidate met the requirements. They shared all correct documentation and obtained the supervisor's signature to confirm they were satisfied with the work completed, demonstrating they understand the handover processes and how to correctly follow them for quality assurance.

The candidate provided a technically detailed functional overview of the system in use and verbally explained the faults found, using correct terminology throughout, and the rectification processes followed. They shared all key documentation and explained these in an appropriate level of technical detail to the assessor.

The candidate clearly addressed the revised maintenance schedule and the peer review feedback received, explaining some feedback they chose to dismiss as it was unnecessary. For example, dismissing the suggestion to reinput the PLC program at each planned maintenance interval as issues with this are through human error that would not be resolved through proactive maintenance, and would just add unnecessary additional cost and time to the maintenance process.

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