T Level Technical Qualification in Maintenance, Installation and Repair for Engineering and Manufacturing - Mechanical

Centre Standardisation Materials

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For external use

Contents

Version and date	Change detail	Section
v1.0 April 2024	Publication of version	n/a

Introduction

Maintenance Engineering Technologies: Mechanical (8712-31) (311)

These standardisation materials have been produced to support centre assessors when marking the Occupational Specialism assessment.

The materials are produced to support staff in the process of marking, including how to effectively use marking grids to mark using assessment themes.

The Occupational Specialism assessments for the T Level in Design and Development for Engineering and Manufacturing are externally set summative assessments which are internally marked by assessors. It is the centre's responsibility to ensure candidate's work is marked in a standard way across the centre, using the specified marking grids, in order to rank performance on a single mark scale.

The marking materials must be considered alongside the Technical Qualification Occupational Specialism assessment guide.

It is recommended that all assessors, including any unlikely to mark, are included in early discussions around the use of the marking grids, as all assessors should understand the basis of marking. This is because it could shape their teaching by helping candidates practise, bringing their skills and knowledge together to complete a problem, and helping them learn to explain and justify their choices in terms of subject knowledge in preparation for summative assessment.

Assessors must study the Technical Qualification Occupational Specialism assessment guide which provides detailed information about the assessment themes and the marking grids, to ensure they are clear about the different assessment themes and how they may show up in evidence across the range of tasks.

If there is more than one assessor carrying out marking at the centre, this process should be carried out as part of a group activity to ensure markers are clear and in agreement about what sorts of evidence are relevant for assessment and which assessment theme they fit into.

The following materials should form the basis for pre-standardisation and discussion could take place using evidence from trial runs/formative assessment activities. Standardisation should also take place using the evidence from the actual assignment set for that year, so along with utilising this tool, please ensure activities surrounding the live assignment also take place.

Thank you for accessing these support materials. Please note that the Practical Observation form has been updated since the publication of these materials. The Practical Observation form included in the live assessment materials is the version that must be used when assessing the Occupational Specialism.

Support and Guidance

Please ensure you have reviewed the information and guidance available in the Occupational Specialism assessment process guide ahead of completing internal standardisation activities.

- TQ Occupational Specialism Assessment Process Guide (PDF)

The following two recordings published on the websites provide support and guidance on student evidence requirements and the application of the Occupational Specialism assessment marking grids.

- Occupational Specialism Student Evidence Requirements
- Application of the Occupational Specialism assessment Marking Grids

This pack contains and references the following material:

- Links to the assessment materials and relevant Guide Standard Exemplification Materials
    - MIR GSEM Mechanical Threshold competence
    - MIR GSEM Mechanical Distinction
- Links to the Sample Assessment Materials – Sample Assessor Pack
    - MIR Practical Assignment Mechanical Sample Assessor Pack
- A partially completed candidate record form, reflecting marking of a number of the assessment themes within this assessment

Candidate A

Assessment details

This standardisation pack has been developed to reflect the requirements of the **Maintenance Engineering Technologies: Mechanical – Sample** version. The assessment pack can be access on the City & Guilds website, here.

The evidence used for the exemplar marking in this pack is based on the **Guide Standard Exemplification** materials for this occupational specialism that can be located, here.

Task 1 - Plan the service and 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.

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Task 1 - Candidate evidence

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

Requirements and Resources	Quantity	Justification
Tools/equipment/materials		
Power supply	1	Power up the milling machine.
Spanner set	1	Different sizes for different jobs on the machine.
Screwdriver set	1	Different types of screwdrivers for different activities.
Plier set	1	To hold items or help with removal.
Allen key set	1	For Allen key fixings.
Measuring implements (D.T.I, Micrometer, Digital callipers, Temp sensors, Rule)	1	To check tolerances, levels and calibration.
Multimeter	1	Conduct electrical tests.
Socket set	1	Remove/refit bolts or nuts.
Torx set and driver	1	Remove/refit Torx bolts/screws.
Pen	1	To complete paperwork.
Spill kit (rags)	1	In case of spilt liquids/fluid.
Funnel	1	Topping up liquids/fluids.
Drill and drill bits	1	In case of needing to remove rivets/bolts.
Spare parts	1	To replace broken or damaged parts.
PPE		
Gloves	1	To reduce chances of injury to hands.
Overalls	1	To protect the body from dirt and solder flux residue.
Safety shoes/boots	1	To reduce chances of injury to feet.
Warning signs and notices		To indicate electrical supplies are isolated.
Technical Information/documentation		
Manuals	For the milling machine.	
Risk assessment	To complete before beginning the task.	
Method statement	To follow during the task.	
Waste disposal	General waste separated, waste fluids in appropriate disposal tanks.	
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, or components not connected etc.	
Input to output	What is expected happens. Operates as expected.	
Half split technique	Break the milling machine down to locate the fault.	

Task 1b – Risk assessment

Risk Assessment				
Hazard	Risk	Control	Likelihood	Severity
Working area throughout the maintenance, servicing and fault-finding activities on the milling machine	Slips, trips and falls.	Ensure area is clean and tidy throughout preparation, maintenance and upon completion. Follow MSDS with any spilt liquids. Wear PPE at all times.	1	1
Manual handling of tools and equipment for maintenance activities	Back injury.	Do not lift over maximum lifting limit. Ensure correct training has been received.	1	1
Working with stored electrical energy whilst carrying out maintenance of the milling machine	Impact injuries, electric shock, burns.	Ensure that correct procedures are followed, and all stored energy is safely discharged. Observe cool down periods.	2	2
Burr / metal filings from previous use	Cuts, splinters, infection	Clean off debris and wear appropriate gloves.	5	2
Working with high temperature	Burns/scalds.	Ensure milling machine has cooled down before removing and replacing parts. Do not handle components whilst still hot.	2	2
Using general hand tools and equipment to undertake maintenance and fault finding on the milling machine	Cuts, abrasions, general hand injury.	Ensure proper use of tools and equipment, particularly drills, torx, screwdrivers and pliers. Ensure correct PPE is obtained and worn, such as gloves when working with fluids and safety glasses to protect from flying debris, such as metal fillings.	1	1
Electricity when working with the milling machine	Electrocution.	Safe isolation following ELV guidance.	2	4
Equipment malfunction / faulty components	Issues with machine whilst modifying / installing new parts.	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

Task 1c – Method statement

Maintenance

- Collect my PPE, tools and equipment that will be needed for the task.
- Put on PPE and visually check the area.
- Remove any objects or items that may cause injury and put out warning signage.
- Adhere to the Health and Safety at work act during all activities.
- Inspect the milling machine visually.
- I will then clean the milling machine down and check connections of equipment and components.
- I will power down the milling machine and lock off the power supply isolating the machine.
- Once the milling machine is switched off, I will remove the lubricating cutting fluid from the machine as part of the maintenance schedule (including a clean of the reservoir) and do the same with the gearbox fluid.
- Replenish fluids and check levels.
- Check spindle for play/end float.
- Check and adjust bed for level.
- Check wires and switches.
- Function and leak test all pumps and motor/s (including pipes). Replace/repair as required.
- Customer complained about longitudinal travel issue, check backlash in both axis leadscrews and adjust to manufacturers spec.
- I will check feed rate.
- I will check that everything is back together correctly and give a general inspection of the milling machine before putting the power back to the machine.
- Once the milling machine is powered back up, I will complete a test run with mild steel.
- 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/assessor.

Task 2 – Perform the service and 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 manufacturer's maintenance record 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 service and 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 condition of the full milling machine prior to any work being carried out – Illustrated in Task 2 photographic evidence section below (photograph 2)

- Photographic evidence showing the milling machine disassembled – Illustrated in Task 2 photographic evidence section below (photographs 3, 4, 5 and 6)

- Photographic evidence showing the working area after disassembly - Illustrated in Task 2 photographic evidence section below (photograph 7)

- Photographic evidence showing the sub-assemblies after repairs have been completed – Illustrated in Task 2 photographic evidence section below (photographs 8, 9 and 10)

- Photographic evidence showing the full milling machine after the maintenance and service has been completed to show final condition and re-instated work area – Illustrated in Task 2 photographic evidence section below (photograph 11)

Task 2 – Candidate evidence

Task 2 – Completed test record

Test record sheet - 03/04/2022

Actions completed -

- Planned maintenance and inspection completed.
- Backlash on axis X and Y led to leadscrew replaced.
- Gearbox drain plug replaced.
- Fluids replenished and grease cleaned off and relubricated.

Milling machine was then ready for final testing.

Testing of the milling machine

- Test the PH level of the cutting fluid 9.5pH (no lower than 8.5 is allowed).
- Power supplied back to the milling machine and then powered on.
- Checked that the milling machine was running as expected by milling mild steel.
- Check for leaks now the system has run.
- Once happy, confirmed that the milling machine was in fact up and running and working as it should be.

Testing of the milling machine is now complete, and the milling machine 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.

Task 2 – Updated maintenance records and control documents

Maintenance log							
			Milling machine type:	Bridgeport			
			Milling machine 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 milling machine was showing signs of gearbox oil leakage. The drain plug was rounded, and leaking item replaced. The maintenance tasks were completed to include the backlash adjustment.	Y		03/04/2022	Planned maintenance completed. Recommend the maintenance schedule is revisited and updated.

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.

.Task 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 area.
- Removing any objects or items that may cause injury and put out warning signage.
- Adhere to the Health and Safety at work act during all activities.
- Inspect the milling machine visually.
- I will then clean the milling machine down and check connections of equipment and components.
- I will power down the milling machine and lock off the power supply isolating the machine.
- Once the milling machine is switched off, I will remove the lubricating cutting fluid from the machine as part of the maintenance schedule (including a clean of the reservoir) and do the same with the gearbox fluid.
- I found a rounded gearbox drain plug.
- Replenish fluids and check levels to include the PH of the cutting fluid.
- Check spindle for play/end float.
- Check and adjust bed for level.
- Check wires and switches.
- Function and leak test all pumps and motor/s (including pipes). Replace/repair as required.
- Customer complained about longitudinal travel issue, check backlash in both axis leadscrews and adjust to manufactures spec. Broken leadscrew found and replaced.
- Dismantle the housing for the worm gearing for both X and Y axis for the table and adjust the backlash to the tolerance as listed in the technical data documentation.
- Grease up the worm gearing of the table.
- I will check feed rate.
- I will check that everything is back together correctly and give a general inspection of the milling machine before putting the power back to the machine.
- Once the milling machine is powered back up, I will complete a test run with mild steel.
- 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.

Task 2 – Practical observation form – work area preparation

Assessment ID	Qualification number
8712-311	8712-31
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. A small toolbox was prepared and placed in the work area but in a way that could have made it a potential obstruction during the work activity. Technical information, including their risk assessment, was collected. This was placed just outside of reach of the work area. The candidate ensured all basic health and safety requirements were followed before the maintenance activities began. Appropriate barrier was used.

Assessor signature	Date
Assessor.1	02/04/2022

Task 2 – Practical observation form – maintenance activities

Assessment ID	Qualification number
8712-311	8712-31
Candidate name	**Candidate number**
Candidate A	CG12345
Centre name	**Assessment theme**
City & Guilds	Health & 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 milling machine. The candidate disassembled the milling machine correctly, referring to the method statement and technical information regularly as an aid. Correct sub-assemblies and components were removed, with components disconnected, and placed onto a work bench. All fluids were drained with consideration to health and safety using a funnel and drain tray, checking fluid levels when replenished. Time was wasted by the candidate by moving from task to task rather than follow a logical sequence.
Fault detection and diagnosis	The candidate completed some visual and physical checks and then addressed the backlash, identifying the issue of the leadscrew. The candidate dismantled the table worm gear correctly and lubricated this up appropriately (with grease). The candidate did not diagnose or rectify the gearbox issue. The candidate moved onto the maintenance process and discovered the excessively worn drain plug. The candidate changed the drain plug. After assembly, the candidate completed a milling machine function check to confirm fault rectification, and so did not complete in a fully logical order or following processes.
Reassembly and recommissioning	The candidate obtained and set up the datum points with minor problems, initially setting these incorrectly, identifying this and rectifying. The candidate completed the maintenance process, but due to not identifying the failed motor gearing, the milling machine was not working within specified tolerances. The candidate did not recognise the split gearbox O ring seal and there was some fluid leaking after use. The candidate mostly

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.*
Working area	returned tools and equipment to appropriate storage but did not clean down these thoroughly before returning them. The candidate then re-energised the milling machine and completed a test run. Worked safely through all activities, following appropriate workshop requirements. Disconnected components were placed on a bench, rather than in containers which could have resulted in a trip hazard if knocked off the bench. Mostly returned tools and equipment to appropriate storage but did not clean down thoroughly. Floor around milling machine had some debris remaining and not fully cleared of obstacles.

Assessor signature	Date
Assessor.1	03/04/2022

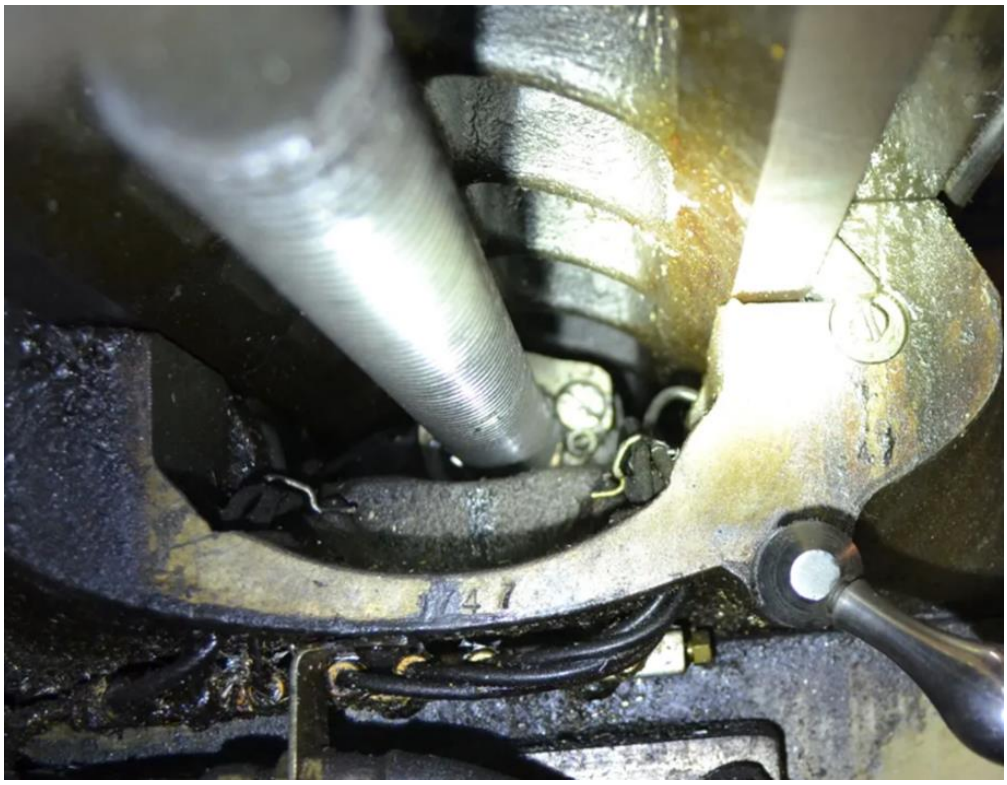
Task 2 – Photographic evidence

Photograph 1: Photographic evidence showing the prepared work area, with small toolbox, health and safety guard but no signage. Technical documentation to hand but not in view. Toolbox shown is a potential obstacle.

Photograph 2: Photographic evidence will show the condition of the full milling machine prior to any work being carried out.

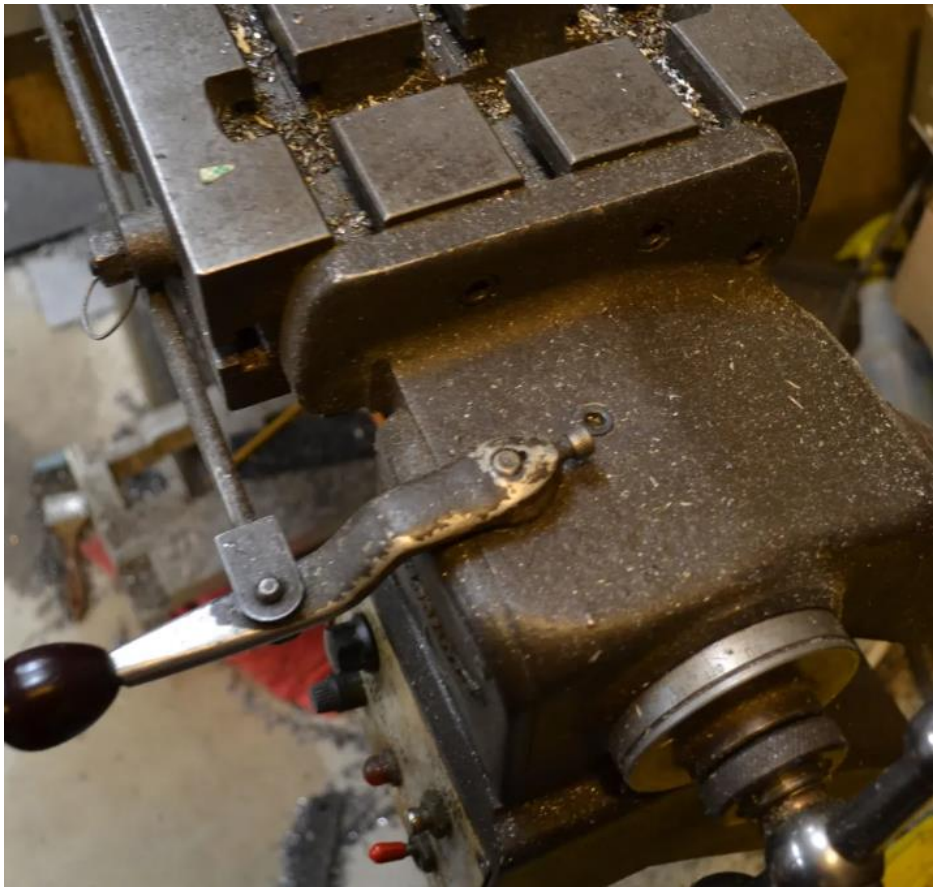
Photographs 3, 4, 5 and 6: Photographic evidence showing the milling machine subassemblies removed before repair.

Photograph 3: Identified lead screw in situ.



Photograph 4: Lead screw removed with working area showing burr, debris and disorganised tools.

Photograph 5: Power feed with burr/debris.



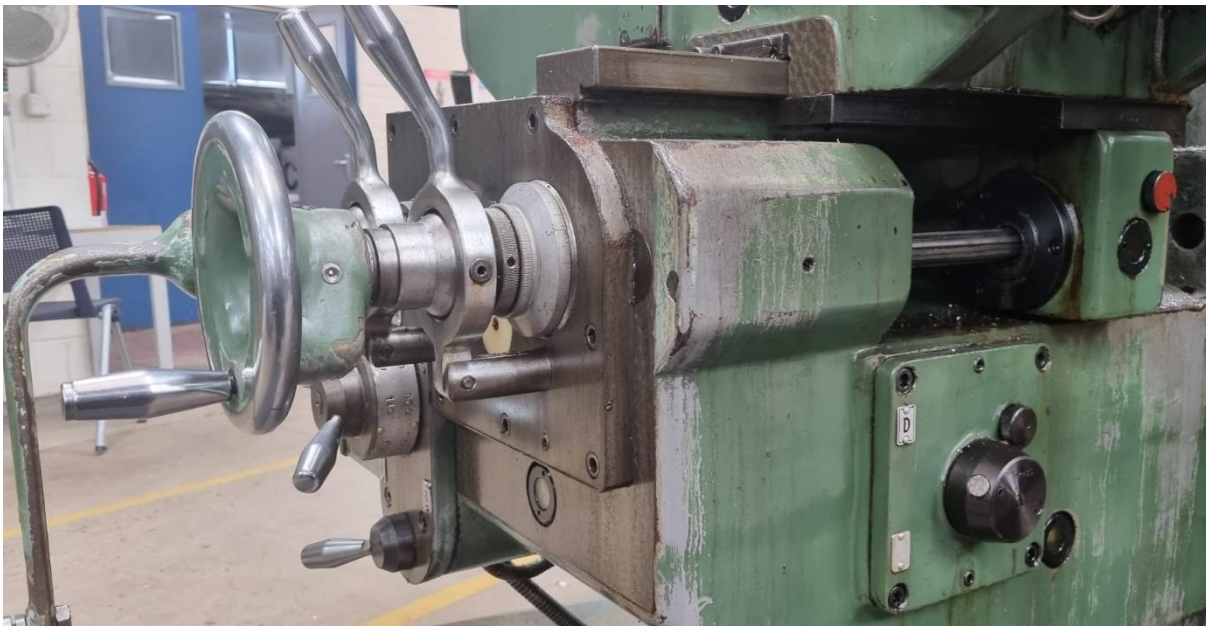
Photograph 6: Power feed removed showing burr has not been cleaned away and tool lying on top.

Photograph 7: Photographic evidence showing the wider working area after disassembly, with parts, components and tools placed on the bench in no logical order. Toolbox remains on the floor a potential trip hazard.

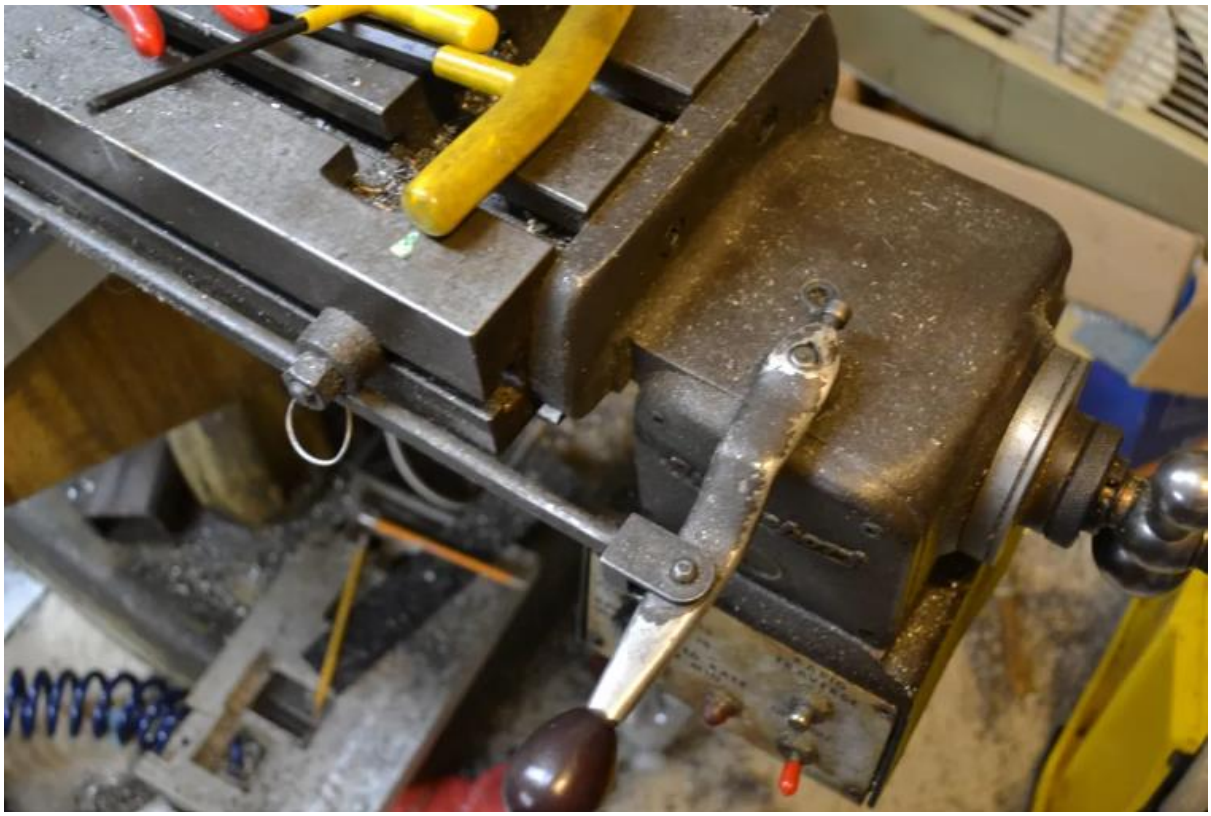
Photographs 8, 9 and 10: Photographic evidence show the sub-assemblies after repairs have been completed. The condition of each sub-assembly following repairs shows an adequate degree and quality of finish, with some areas cleaned and others not.

Photograph 8: Lead screw and nut refitted, and housing has not been swept clean.

Photograph 9: Reassembled feed control wheel, which has been cleaned of burr/debris.



Photograph 10: Power feed refitted, working area messy with pencils and debris, top of motor has been swept clean, but the rest of the sub-assembly has remaining burr/debris.



Photograph 11: Photographic evidence showing the full milling machine after the maintenance and service has been completed. The machine has been mostly cleaned, the working area shows the debris and items remaining on the floor and not all tools have been returned to appropriate storage.

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.

Task 3a – Candidate evidence

Task 3a – Technical report

Bridgeport milling machine	04/04/2022

The milling machine needed the scheduled maintenance to be completed. The milling machine to be maintained is used for repetitive milling processes. The milling machine also includes a digital read out which is used to control the milling machine operations.

The maintenance included fixing any faults that had been reported or other faults that I may come across during the task. The information required for the task was provided through a brief as well as specifications of the milling machine which were used to check the milling machine was functioning 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 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. The first task that needed to be completed was a visual inspection to visually check the condition of the milling machine and identify any damage or wear and tear to the milling machine. Followed by cleaning out the cutting fluid and replenishing this, checking for leaks or blockages to the pipes.

When I looked at the drain plug for the gearbox oil, I noticed that this was rounded and that there was a leak. I asked for a new drain plug, this was replaced and tightened to prevent further leaks.

I then continued on with the maintenance required, checking the spindle to be within the expected values of tolerance and spinning true – it was fine. I dismantled the milling machine and lubricated the gears with the required grease and oil. I then continued to dismantle to gain access to the leadscrews to adjust the backlash. This was worn excessively (on the x axis), I gained a new leadscrew and fitted it. I then checked that the bed was level and true using an engineer's square, spirit level and feeler gauges.

I re-assembled the milling machine making sure to follow the datum alignment markings and making sure everything was tight and secure.

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 (toolbox and tool cupboard) and putting all rubbish in the bin. Stock used was:

- X axis leadscrew
- gearbox drain plug
- gearbox oil
- cutting fluid.

Overall, I managed to complete the maintenance tasks, resulting in a milling machine that operates more effectively. However, the intermittent fault was not found, so I recommend further investigation on the system to find and resolve.

Task 3a – Revised maintenance schedule

Milling machine:	**Findings during maintenance:**	**Recommendations to seniors:**	**Justification to seniors:**	**Recommended next planned maintenance due date:**
Bridgeport milling machine	Gearbox drain plug rounded and replaced. Worn leadscrew is a wear and tear item, this was broken and replaced.	It is recommended that the milling machine bed is monitored for vibration and reported for further investigation as required. A vibration felt on the bed before work, slight negotiable vibration felt when work completed no further faults found.	Vibration felt on the bed could be caused by faults not yet discovered so investigating further now may avoid faults getting worse and leading to more machine downtime.	02/04/2022 Reactive investigation ASAP

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.

Task 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 continue on a yearly basis which is a typical maintenance schedule, but a long period of time. The documents produced allow for the maintenance to be recorded clearly.*
How appropriate are the recommended planned maintenance intervals and why?	*12 months is a long period of time for the nature of the milling machine when vibration was still noted this could deteriorate and effect finish/quality of final product.*
What are the implications to the business of the proposed maintenance schedule?	*Further investigation recommended but no alteration to the planned maintenance schedule, having to complete ad-hoc reactive maintenance may be more costly to the business due to machine downtime reducing its productivity and efficiency.*
How can the maintenance schedule could be optimised/ improved?	*Where candidate. A has suggested completing further investigation only. I feel that the maintenance should be completed on a 6 monthly milling machine as to prevent faults not being reported and maintain full accuracy of the milling machine. Because the leadscrew was excessively worn, I would also recommend replacing this each time planned maintenance is carried out to avoid this happening again.*

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 enables planned maintenance to be completed on a yearly basis which is a commonly used maintenance schedule, but I think is too long for this type of machine that is used so consistently. The documents produced allow for the maintenance to be recorded clearly.*
How appropriate are the recommended planned maintenance intervals and why?	*12 months is a long period of time for the nature of the milling machine and may cause further issues down the line because of the vibration still felt within the machine. Recommending reactive maintenance rather than preventative maintenance may not support the machine to be productive and may cause health and safety issues for the operators as well.*
What are the implications to the business of the proposed maintenance schedule?	*Reactive maintenance will be more costly to the business as this will include increased system downtime than completing more regular planned maintenance activities.*
How can the maintenance schedule could be optimised/ improved?	*Where candidate. A has suggested further investigation, they have not suggested a timescale. Further investigation and resolution should include a timescale to ensure this is completed appropriately. I feel that the maintenance should be completed on a 3 monthly basis due to the nature and consistent use of the machine and would ensure faults are caught early and reduce machine downtime.*

Task 3b – Candidate evidence

Task 3b – Maintenance schedule amended from peer review feedback

System:	Findings during maintenance:	Recommendations to seniors:	Justification to seniors:	Recommended next planned maintenance due date:
Bridgeport milling machine	Gearbox drain plug rounded and replaced. Worn leadscrew is a wear and tear item, this was broken and replaced.	It is recommended that the milling machine bed is monitored for vibration and reported for further investigation as required. A vibration felt on the bed before work, slight negotiable vibration felt when work completed no further faults found. Upon reviewing of the peer feedback, I recommend that the leadscrew should be replaced at each planned maintenance interval.	Vibration felt on the bed could be caused by faults not yet discovered so investigating further now may avoid faults getting worse and leading to more machine downtime.	02/10/2022 Reactive investigation and resolution to be completed by 18/04/2022

Justification for changes:

From peer feedback, it was highlighted that due to outstanding vibration issues identified within the machine, reactive maintenance should state a date for further investigation and resolution to be completed, so I recommend this is completed within two weeks of today's date. Peer review feedback highlighted that maintaining the original schedule intervals of 12 monthly was too long due to the nature and consistent use of the machine, so I am now recommending that planned maintenance is completed every 6 months. It was also recommended because of the diagnosed and resolved issue with the leadscrew, this component should be replaced at each planned maintenance activity to avoid repeated issues with this component as this is a common issue.

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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.

Task 4 – Candidate evidence

Task 4 – Handover documentation

Maintenance log							
			Milling machine type:	Bridgeport			
			Milling machine 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 milling machine was showing signs of gearbox oil leakage. The drain plug was rounded, and leaking item replaced. The maintenance tasks were completed to include the backlash adjustment.	Y	*Assessor. 1*	02/10/2022	Planned maintenance has been completed but vibrations felt on the bed so recommend further investigation, which should be completed by 18/04/2022. Maintenance schedule updated.

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?**	**Person to revise any issues with diagrams and specifications:**
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.

Revised Maintenance Schedule – Bridgeport Milling Machine				
System:	**Findings during maintenance:**	**Recommendations to seniors:**	**Justification to seniors:**	**Recommended next planned maintenance due date:**
Bridgeport milling machine	Gearbox drain plug rounded and replaced. Worn leadscrew is a wear and tear item, this was broken and replaced.	It is recommended that the milling machine bed is monitored for vibration and reported for further investigation as required. A vibration felt on the bed before work, slight negotiable vibration felt when work completed no further faults found. Upon reviewing of the peer feedback, I recommend that the leadscrew should be replaced at each planned maintenance interval.	Vibration felt on the bed could be caused by faults not yet discovered so investigating further now may avoid faults getting worse and leading to more machine downtime.	02/10/2022 Reactive investigation and resolution to be completed by 18/04/2022

Justification for changes:

From peer feedback, it was highlighted that due to outstanding vibration issues identified within the machine, reactive maintenance should state a date for further investigation and resolution to be completed, so I recommend this is completed within two weeks of today's date. Peer review feedback highlighted that maintaining the original schedule intervals of 12 monthly was too long due to the nature and consistent use of the machine, so I am now recommending that planned maintenance is completed every 6 months. It was also recommended because of the diagnosed and resolved issue with the rectifier diode, this component should be replaced at each planned maintenance activity to avoid repeated issues with this component as this is a common issue.

Task 4 – Practical observation form – handover

Assessment ID	Qualification number
8712-311	8712-31
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 they completed during the maintenance activity sufficiently, describing issues encountered during their approach to the fault finding. The candidate described the two faults they found during the maintenance activity. The candidate explained that the digital readout was displaying the correct values during the functional walk through of the milling machine. They stated that they could feel an unusual vibration on the bed of the milling machine so recommend further investigation which should be completed by 18/04. The candidate outlined the key points where they had changed their method statement and gave a brief account of why this was necessary. The candidate provided a brief functional walk through of the milling machine in operation. This however contained limited reference to their inspection and test results from the maintenance activity. Technical terminology was used correctly but 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 reducing the intervals from the original 12 months to 3 months. The candidate decided this was unnecessary and costly, so agreed with the second peer who had suggested 6 monthly intervals instead. 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.

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.*
	The candidate demonstrated good communication using some technical terminology appropriate to the audience, but mostly 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 milling machine.

Assessor signature	Date
Assessor.1	05/04/2022

Guidance on the exemplar marking

Marking Grids for each assessment theme are found within the Assignment Assessor Pack and gives guidance on banding descriptors, marks available within each band as well as indicative content that provides guidance on knowledge, understanding and skills within the assessment theme.

For the purposes of these materials the Marking Grids used can be found in the Sample Assessment Materials here.

Within this standardisation pack, a partially completed CRF form has been provided that outlines how an assessor has awarded marks against the candidate evidence for a number of the assessment themes using the Marking Grid included in the Sample Assessment Materials.

For exemplification purposes, an explanation of how the marker has determined the mark to be awarded is provided, this exemplary document showing.

- How the marker has first considered the marking bands available and determined within which band the evidence best fits.
- Subsequently, consideration within the determined band and justification for the mark to be awarded within that band.

Candidate Record Form (CRF) – Mechanical (8712-311)

Planning and preparation									
Preparation									
	Band 1			**Band 2**			**Band 3**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Mark 5	Notes and justification: The overall evidence meets the band 2 descriptors: Work area well prepared and tidied with visible safety barrier to protect other colleagues. Limited range of materials, components and resources selected with some consideration of working condition, serviceability, or feasibility. Clear consideration for the condition, quality and performance of tools and equipment through completing a good range of preparatory checks. Work area prepared with clear consideration of the prepared method statement and workflow, with completed calibration checks on most selected tools and equipment. The evidence demonstrates some understanding and application of the required processes and procedures. However, the limited range of materials, components, and resources selected, coupled with a lack of depth in resource evaluation and planning, prevents it from meeting the criteria for the top high marks in Band 2. To achieve a higher mark, there needs to be a broader scope in material selection, along with a more comprehensive and strategic approach to project planning and execution.								

Systems and components												
Inspection and testing												
	Band 1				**Band 2**				**Band 3**			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Mark 4	Notes and justification: The evidence meets the band 1 descriptors Some understanding and application of inspection and testing methods shown through selection and completion, there are notable issues with the use of suitable test and measurement equipment. This indicates a lack of proficiency in ensuring the accuracy and reliability of the testing process, which is crucial for obtaining valid and actionable results. Basic interpretation and application of some parameters or tolerances. Some units of measurement and calculations used appropriately, but with limited accuracy. The report shows a basic level of interpretation and application of some parameters or tolerances. However, the application of these parameters lacks depth and precision. This superficial understanding suggests a potential compromise in the quality and integrity of the inspection and testing process, as critical nuances may be overlooked.											

	While some units of measurement and calculations were employed appropriately, the overall accuracy is questionable. Precision in measurement and calculation is paramount in inspection and testing procedures to ensure the reliability and validity of the results. Lastly, the evidence indicates that some outputs, data, or readings were compared with manufacturer's specifications. However, discrepancies were not consistently identified, and there was only partial adherence to recording procedures. The evidence meets all the descriptors of band 1 so it is top marks in the band. While showing some understanding and application of inspection and testing methods, there is a lack of precision, accuracy, and attention to detail. The inconsistencies in equipment setup, interpretation of parameters, measurement accuracy, and adherence to recording procedures preventing the evidence from meeting the criteria for a Band 2 mark.

Working with faults									
Detection and diagnosis									
	Band 1			**Band 2**			**Band 3**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Mark 4	Notes and justification: Overall the evidence meets the band 2 descriptors: There is a good systematic and logical approach to fault detection and diagnostic techniques, indicating a comprehensive understanding and application of fault-finding procedures. However, while this systematic approach is commendable, only one or two faults were correctly diagnosed using at least one appropriate fault detection and diagnostic technique There was some level of accuracy in diagnosing faults but it is not consistent. Some diagnostic and measurement information used to determine the causes of the faults and create a limited schedule of tasks for reactive and preventative maintenance activities. While the evidence demonstrates reasonable understanding and application of fault detection and diagnostic techniques, it falls short in terms of accuracy in diagnosing faults and the comprehensiveness of the schedule of tasks for maintenance activities. This positionsthe evidence within the lower Band 2 , indicating a need for improvement in the diagnostic accuracy and depth of analysis in fault management processes.								
Resolution									
	Band 1			**Band 2**			**Band 3**		
	1	**2**		**3**	**4**		**5**	**6**	
Mark 2	Notes and justification: The evidence meets the band 1 descriptors so the mark is at the top of the band The evidence identifies resolution methods for the faults encountered; however, there is minimal reference to manufacturer's specifications and only brief consideration of recording procedures. While some effort has been made to address the issues, the effectiveness of the resolution methods is questionable, suggesting a need for improvement in adhering to established guidelines and standards.								

	One or two faults were repaired to an acceptable standard with limited consideration of timeframes or standards and adherence to processes. This indicates that while some corrective actions were taken, it would not meet the descriptors for band 2. Calibration of machine components completed, but not working within specified tolerances. The evidence demonstrates a basic understanding and application of fault resolution methods and repair processes, The limited effectiveness, adherence to standards, and calibration accuracy means it does not meet the band 2 descriptor.

Reviewing and reporting						
Reviewing						
	Band 1		**Band 2**		**Band 3**	
	1	**2**	**3**	**4**	**5**	**6**
Mark 4	Notes and justification: The evidence aligns to the band 2 descriptors The evidence demonstrates changes to maintenance processes and procedures in response to feedback. While these changes are suitable and accompanied by some reasoning, including an appropriate date provided for the next planned maintenance activity, they lack the depth and comprehensiveness required for Band 3. Additionally, where no improvements or adaptations are made to maintenance processes and procedures, the evidence provides good reasoning and justifications for the lack of changes. While this demonstrates a thoughtful approach to decision-making and maintenance strategy, it does not meet band 3 descriptor. The absence of proactive improvements or adaptations, even with sound reasoning, indicates a reactive rather than a proactive approach to maintenance management, which is a characteristic of a band 2. Overall the evidence meets the descriptors of the band 2 so it is top marks within that band.					

Internal assessor signature	**Date**

Total
*/90

* Please Note that the Total Mark (90) applies to the full assignment including all Assessment Themes

Candidate B

Assessment details

This standardisation pack has been developed to reflect the requirements of the **Control and Instrumentation Sample** version. The assessment pack can be access on the City & Guilds website, here.

The evidence used for the exemplar marking in this pack is based on the **Guide Standard Exemplification** materials for this occupational specialism that can be located, here.

Task 1 - Plan the service and 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.

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Task 1 - Candidate evidence

Task 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**
Power supply and pneumatics	1	To power the system, supply voltage 230 V for the milling machine to work/operate.
Scientific calculator	1	Feeds and speeds calculations to ensure accuracy.
Spanner set (ring, box, open)	1	For nuts/bolts fixings/fastenings.
Driver set	1	Different types of drivers for different fixtures and fixings.
Plier set	1	To hold items or help with removal.
Pen	1	Complete paperwork.
Socket set	1	To use on the torque wrench or other appropriate components/fixings/fastenings.
Multimeter	1	Conduct electrical tests.
Funnel	1	To top up fluids/liquid.
Measuring implements (D.T.I, micrometer, digital callipers, temp sensors, Rule)	1	To check tolerances, levels and calibration.
Combination set	1	Checking angles.
Drill and drill bits	1	In case of needing to remove rivets/bolts.
Tap and die set	1	In case of rethread.
Adjustable spanner	1	Undoing nuts, bolts and various fixing and fastenings.
Spare parts	As required	If any fixings break these will require replacement to keep machinery in action.
Stanley knife	1	Various jobs.
Materials and consumables *The following will be needed to undertake the maintenance activities.*		
Rags and cleaning fluids	As required	Once the work is complete the floor and or surfaces require cleaning with a detergent or degreaser. Rags are helpful during the process to deal with small leaks or spillages.
Spill kit	1	In case of large spillages of fluid.
Oil (appropriate grade for task)	1	For lubricating moving parts as per the instruction manual.
Grease	1	To lubricate all joints/moving parts as appropriate.
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).*		
Gloves (disposable)	1	To reduce chances of injury/contamination to hands, also to provide extra grip. Worn throughout the whole process.
Goggles	1	To use when using spray lubricants and at other times when there may be a risk of eye injury present. Used to prevent ingress or eye damage.

Overalls	1	Basic PPE requirements meeting HASAWA. To protect clothes from dirt, water and other contaminants that may result from the process. Protection of the body from hot objects.
Safety shoes/boots	1	Basic PPE requirements meeting HASAWA. Limit injuries from instruments, tools and equipment causing damage to feet.
Warning signs and notices		To indicate that air and electrical supplies are isolated, informing others in the work 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
Manuals	For the milling machine, to ensure all information is on hand for reference. Instructions and frequently asked questions for use, maintenance, disassembly, repair and installation of the complete system and individual sub-assemblies.
MSDS for lubricants	To provide preventative and other COSSH related information when lubricating the joints etc.
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 the maintenance activity 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	Wiring and general waste separated following legal requirements (WEEE Reg's etc).
Time needed	Prepare the work area 1 hour Decommission and inspect system 2 hours Fault finding and diagnosis 3 hours Repair 2 hours Calibration 30 mins Recommission 1 hour Recording 1 hour Re-instating work area 30 mins
Access requirements	Ladder or appropriate steps, follow working at height regulations to access the drive motor.
Fault finding/diagnostic techniques and methods	
Sensory checks	Using my senses to detect noise, vibration or unusual sounds/scents. Visually inspect the system to identify any obvious issues, such as a fault being displayed on the digital read out, 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 a buzzing or rattling.

	Touching the system could indicate whether the machine is within expected operational temperatures and feel for any vibration.
Input to output	Checking that what is required of the machine is happening to the expected values and accuracies.
Half split technique	Check hydraulic systems and operations, electric system and operations. Splitting the fault location down to a specific location (half split).
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. This is not a preferred method due to the cost implications but is part of the rectification process.

Task 1b – Risk assessment

Preparation				
Hazard	Risk	Control	Likelihood	Severity
Organisation of the working area whilst 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. Ensure area is clean and tidy throughout preparation, maintenance and upon completion.	2	1
Presence of burr / metal filings on the areas of the machine where hands may be placed during maintenance	Cuts, splinters, infection.	Clean off debris when preparing the machine and work area. Wear thick gloves when working on/near the table where a high build-up of debris is possible.	5	2
Manual handling of tools and equipment into the area needed for maintenance	Personal injury.	When obtaining equipment and tools ensure awareness of maximum lifting weight. Ensure correct training has been undertaken.	2	1
Preparation of hand tools and equipment for the maintenance to be carried out	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 and fault finding				
Hazard	Risk	Control	Likelihood	Severity
Cleanliness and organisation of the working area throughout the maintenance of the milling machine	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
Working with stored energy when undertaking work on the milling machine (electrical)	Impact injuries, electrical shock.	Remove power from system. Ensure electrical components are discharged and given appropriate time to power down prior to maintenance taking place.	2	2
Presence of burr / metal filings on the areas of the machine where hands may be placed during maintenance	Cuts, splinters, infection.	Wear appropriate gloves when working on or near the table where a high build-up of debris is possible.	5	2
Working at height to access all areas of the milling machine for maintenance	Falls, injuries to personnel.	Ensure appropriate training before working at height and following Working at Height Regulations.	3	2
Working with machinery where high temperatures are present	Burns/scalds.	Ensure milling machine has cooled down before removing and replacing parts.	2	2
Hand tools and equipment	Cuts, abrasions, general hand injury.	Ensure correct selection and use of tools for the activity. Ensure proper use of tools and equipment, particularly pliers and drills. Ensure correct PPE is obtained and worn, such as gloves when working with hot components and safety glasses to protect from flying debris. Ensure sufficiently trained in the use of hand tools and any test equipment. Follow PUWER regulations.	2	1
Spilt liquid from the milling machine during maintenance	Slipping, injury to personnel.	If a spillage is to occur ensure correct MSDS procedures are followed to clean up, using the spill kit, cloths and rags.	2	1
Equipment malfunction/ faulty components	System heating up when working on it.	Isolate/power off the system when removing and replacing components and equipment.	3	2
Working with electricity in a live system (mains and low voltage)	Electrocution	Ensure safe isolation is carried out, ensuring that electrical supplies are locked off, following LOTO regulations. Use voltage tester and proving unit to ensure that there is no power coming into the system. Follow requirements of the Electricity at Work Regulations (1989).	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

Task 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 that 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 required and appropriate 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. I will 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 milling machine and function check the milling machine to ensure that it is in an operational condition and a healthy state. I will start by running a process to see in what 'state' it currently runs in and check the accuracy of the datum points.

It has been indicated to me that there is an intermittent fault on the longitudinal travel therefore I will be conducting fault finding processes, using more than one style to locate, identify and diagnose the issues with success.

If any faults should arise, I will apply the appropriate fault-finding techniques to investigate and diagnose any potential causes. For example, if the longitudinal travel is excessive, then I will refer to the manual for guidance of the machine tolerances. I will then investigate to find the fault(s) and prove the item or component found to be faulty is confirmed as being faulty before replacing or repairing. I will conduct any testing that may be required, remove and replace any equipment and components that may be faulty. Once all the faults have been rectified, I will commence with the maintenance activity.

If diagnosis is not appropriate, then I will proceed to follow the maintenance schedule as listed in the manual and record my findings and diagnose as I go.

Once I am satisfied following the IET guidance I will switch off the supply. I will lock off the supply to ensure it cannot be re-energised whilst I am working on it.

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

gears and surfaces for wear, tear and lubrication, lubricating with the appropriate grease or oil (as per the specification).

I will check the entire milling machine, assemblies and sub-assemblies for security and tightness, if any fastenings/fixing are showing signs of wear and tear then these will be replaced as appropriate. During this maintenance I will need to check the running of and replace the lubricating cutting fluid. To do this I need to drain the lubricating cutting fluid from the reservoir and gain the appropriate access to catch the fluid. I will clean the reservoir tank and refill the cutting fluid, checking the PH with the dip sticks and refractometer. Once this has been done and safely stored, I can proceed to remove, inspect for filings and replace the gearbox oil. The reason for checking for filings is to indicate excessive wear on the gears. Then this will need to be assembled and tightened in accordance with the manual. I will dismantle the X and Y axis worm gears housing and check the tolerance values for backlash adjusting the leadscrews to correct tolerance values. I will proceed to check the bed is true and level using a sprit level, feeler gauges and an engineer's square. I will check the spindle for radial or end float. I will do this using a DTI gauge and/or digital vernier gauges and check this against the technical data for accuracy.

Once I am happy, I will reassemble the milling machine in the correct order, torquing up the main fixings to the appropriate torque. The sub-assemblies are mainly nuts and bolts and these will be tightened as per the manufacturer's specification. During the reassembly process there are alignment markings that need to be checked and set to the appropriate datum so that the milling machine preforms 'true' and with precision. These alignment/datum settings are described in the manual and will be followed to ensure final correct operation. Another very important process to be followed is to ensure all greased components are cleaned off and re-greased. The same applies to the oiled surfaces. It is important to clean and reapply the oil and grease as it likely contains debris and carbon deposits from general use of the machine. As it is high temperature grease, it can become hard/waxy over time, which could cause seizing of important components if not refreshed.

I will then function check the milling machine and ensure the milling machine is operating correctly. I will check feeds to make sure that the speed is accurate to what setting it is set to. I will operate a general milling task with some mild steel block to confirm all settings are true and the performance is accurate, measuring the piece with digital vernier gauges and inspecting it for finish quality.

Post-maintenance

Once I am satisfied that the maintenance has been completed, I will tidy up my work 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 are followed. I will then handover the milling machine to the assessor, demonstrating the milling machine 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 supervisor.

Task 2 – Perform the service and 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 service and 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 condition of the full milling machine prior to any work being carried out – Illustrated in Task 2 photographic evidence section below (photograph 2)

- Photographic evidence showing the milling machine subassemblies removed before repair. – Illustrated in Task 2 photographic evidence section below (photographs 3, 4 and 5)

- Photographic evidence showing the working area after disassembly - Illustrated in Task 2 photographic evidence section below (photograph 6)

- Photographic evidence showing the sub-assemblies after repairs have been completed – Illustrated in Task 2 photographic evidence section below (photographs 7, 8 and 9)

- Photographic evidence showing the full milling machine after the maintenance and service has been completed to show final condition and re-instated work area – Illustrated in Task 2 photographic evidence section below (photograph 10)

Task 2 – Candidate evidence

Task 2 – Completed test record sheets

Bridgeport Milling machine – Test Record - completed 04/04/2022			
Steps to follow	**Checked**	**Repaired / method used to repair**	**Comments**
Cutting fluid replaced and tank cleaned	✓	✓ Drained, cleaned and replenished.	PH checked with dip. 9.5 PH reading.
Cutting fluid supply pipes checked for cleanliness	✓		Pipes in good condition all fluid flows freely, no blockages.
Gearbox oils drained, inspected and replenished	✓	✓ No excessive metal filings present, oil clearly used and dirty. Filled until level gauge indicated the correct level.	Mill gear EP220 used.
Fluid levels checked	✓		All levels correct on visual float.
Check all electronic connections are sound	✓		All electronic connections are sound, no signs of wear and tear present.
Visual check of wires	✓	✓ 1 wire retaining clip very worn and requires future replacement.	No wires fouling machinery.
Check for leaks	✓	✓ Gearbox O ring split. Replaced with new seal and oil drain plug due to being rounded. Leaks checked when machine running post repair.	New parts fitted.
Visual inspection for any defects	✓	✓	N/A
Motor and pumps	✓		All working correctly. Vibration felt on table – investigate.
Noises and vibrations	✓	✓ Noise present (chattering) from feed motor when speed is + 90 fpm (feed per min) - HSS (High Speed Steel) tooling used. Upon investigation, the feed motor gears have excessive backlash in gearbox with teeth excessively worn. Gearbox housing dismantled, motor removed for access, grub screw removed from shaft, bevelled tooth gear removed from shaft. Replaced bevel toothed gear with a new one checking dimensions (teeth/diameter), fitting new grub screw. Relocate motor with shaft into gearbox – checking backlash against technical information.	Vibration noted when test running machine with mild steel, finish impaired.
Spindle for radial or end play	✓	No excessive play or wear, used DTI gauge and vernier to double check measurements.	Within tolerance.
Bed for level	✓	✓ Minor adjustment made turning the levelling screws until the bubble in the level is centred.	Level and true.
Backlash adjustment	✓	✓ Adjusted using extra-long reach screwdriver, X axis leadscrew replaced due to being broken.	X axis leadscrew renewed.
Check feeds if auto	✓	Correct and within tolerance after gearing replaced – see attached technical document for values.	Within tolerance.
Table saddle checked for clearance/condition	✓	Table saddle (both axis) checked for clearance with feeler gauges.	Within tolerance.

Task 2 – Updated maintenance records and control documents

Maintenance log							
			Milling machine type:	Bridgeport			
			Milling machine 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. B	Scheduled maintenance and intermittent fault diagnosis.	The milling machine was showing signs of gearbox oil leakage. Upon inspection the drain plug was rounded and the sealing O ring split, both items replaced with new. The maintenance tasks were completed to include the backlash adjustment, replacing the X axis leadscrew due to being excessively worn. Table feed gear box noise, bevel gear to be excessively worn. Gearbox dismantled to replace the worn bevel gear. Electric wire retaining clip worn, recommend replacement with new.	Y X axis leadscrew. Gearbox drain plug. Split drain plug sealing ring. Feed drive motor gear box bevel gear replaced.		03/04/2022	The machine was successfully run to check for any leaks or noises and run with a test piece of mild steel to check for finish defects which could indicate faults. Planned maintenance has been completed, however it is advised that the maintenance schedule is revisited. More regular maintenance will ensure sources of potential faults can be identified earlier and before they cause the system to become non-functional.

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?**	**Person to revise any issues with diagrams and specifications:**
03/04/2022	Candidate. B	Yes, most up to date diagrams and specifications are being used. V2.1	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, they would have been relayed to the supervisor who would then contact the document controllers as per chain of command.

.Task 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 that 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 required and appropriate 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. I will 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 milling machine and function check the milling machine to ensure that it is in an operational condition and a healthy state. I will start by running a process to see in what 'state' it currently runs in and check the accuracy of the datum points.

It has been indicated to me that there is an intermittent fault on the longitudinal travel therefore I will be conducting fault finding processes, using more than one style to locate, identify and diagnose the issues with success.

If any faults should arise, I will apply the appropriate fault-finding techniques to investigate and diagnose any potential causes. For example, if the longitudinal travel is excessive, then I will refer to the manual for guidance of the machine tolerances. I will then investigate to find the fault(s) and prove the item or component found to be faulty is confirmed as being faulty before replacing or repairing. I will conduct any testing that may be required, remove and replace any equipment and components that may be faulty. Once all the faults have been rectified, I will commence with the maintenance activity.

If diagnosis is not appropriate, then I will proceed to follow the maintenance schedule as listed in the manual and record my findings and diagnose as I go.

Once I am satisfied following the IET guidance I will switch off the supply. I will lock off the supply to ensure it cannot be re-energised whilst I am working on it.

I will proceed to clean down the milling machine as part of maintenance to prevent any debris from getting inside the milling machine when the sub-assemblies/covers are removed. Once I am happy the milling machine is cleaned, I will remove any sub-assemblies to gain access to the components. I will visually inspect the components and wiring of the milling machine to ensure all connections are electrically sound and that no damage or wear and tear is visible. I will also check all gears and surfaces for wear, tear and lubrication, lubricating with the appropriate grease or oil (as per the specification).

***Approach to fault finding**: Upon visual inspection and checking for leaks of the milling machine, I found the gearbox oil drain plug to be rounded and the oil seeping out of this location. To remove the rounded drain plug I firstly got a socket and tapped this on with a dead blow mallet. I then attached a ratchet, and this just spun the socket off, I tried the same*

process again with a slightly smaller socket, but this did not work. I used a pair of vice grips to hold onto the remainder of the drain plug and twisted the drain plug off by hand, catching the fluid in a drain tray. Once the drain plug was removed, I then discovered through visual inspection I found the O ring seal to be broken, this would indicate the cause of the leak. These were replaced with new and torqued up to the appropriate values.

I will check the entire milling machine, assemblies and sub-assemblies for security and tightness, if any fastenings/fixing are showing signs of wear and tear then these will be replaced as appropriate. During this maintenance I will need to check the running of and replace the lubricating cutting fluid. To do this I need to drain the lubricating cutting fluid from the reservoir and gain the appropriate access to catch the fluid. I will clean the reservoir tank and refill the cutting fluid, checking the PH with the dip sticks and refractometer. Once this has been done and safely stored, I can proceed to remove, inspect for filings and replace the gearbox oil. The reason for checking for filings is to indicate excessive wear on the gears. Then this will need to be assembled and tightened in accordance with the manual. I will dismantle the X and Y axis worm gears housing and check the tolerance values for backlash adjusting the leadscrews to correct tolerance values. I will proceed to check the bed is true and level. I will check the spindle for radial or end float. I will do this using a DTI gauge and or digital vernier gauges and check this against the technical data for accuracy.

***Approach to fault finding**: Upon checking and adjusting the milling machine backlash on the axes, I found the leadscrew to be broken on the X axis. I came to this conclusion by trying to adjust the backlash on the leadscrew using an extra-long reach screwdriver and the adjustment screw was spinning without tension. I removed the worm gear shaft from its housing by undoing the adjustment screws and giving the shaft a gentle nudge to get it off its seat. Once this was dismantled from its housing and upon inspection the leadscrew was clearly worn and a new one fitted, adjusting to the appropriate backlash values after reassembly.*

Once I am happy, I will reassemble the milling machine in the correct order, torquing up the main fixings to the appropriate torque. The sub-assemblies are mainly nuts and bolts and these will be tightened as per the manufacturer's specification. During the reassembly process there are alignment markings that need to be checked and set to the appropriate datum so that the milling machine preforms 'true' and with precision. These alignment/datum settings are described in the manual and will be followed to ensure final correct operation. Another very important process to be followed is to ensure all greased components are cleaned off and re-greased. The same applies to the oiled surfaces. It is important to clean and reapply the oil and grease as it likely contains debris and carbon deposits from general use of the machine. As itS i's high temperature grease, it can become hard/waxy over time, which could cause seizing of important components if not refreshed.

***Approach to fault finding**: Upon checking the feed I found the operation to be excessively noisy and this was due to the table feed motor gearbox gearing to be excessively worn, creating a chatter noise. How I found this was through elimination, the noise and vibration was coming from the feed motor. I immediately drew my attention to this area, to effectively diagnose this I needed to isolate and remove the motor from the machine. Once the motor was off the feed shaft this is when I could manually rotate the shaft by hand, in doing so I could feel the end float. I checked the engagement gear side of the motor, and this seemed to be okay, within a negotiable amount of movement not to cause concern. My attention went back to the gearing drive that attaches the motor to the feed shaft. This was dismantled to make a visual inspection and allowed me to diagnose efficiently the excessive play/end float. To remove the bevel gear in question I needed to remove a grub screw and use a*

small pulley to help slide the gear off the shaft. Once this was in my hand, I could clearly see the wear (indicated by shiny metal), I checked the other gear it attaches to rotate drive through 90 degrees, this seemed to be okay. I asked for a new gear and reassembled the gear onto the shaft, greased it up and checked tooth engagement before happily reassembling the gearbox, motor and feed drive assembly back to the machine. To confirm rectification, I needed to make the machine live again by turning on the electric power supply and engaging the feed speeds through the full range of drive speed. No noise or vibration was found; therefore, I believe the rectification was successful.

I will then function check the milling machine and ensure the milling machine is operating correctly. I will check feeds to make sure that the speed is accurate to what setting it is set to. I will operate a general milling task with some mild steel block to confirm all settings are true and the performance is accurate, measuring the piece with digital vernier gauges and inspecting it for finish quality.

Post-maintenance

Once I am satisfied that the maintenance has been completed, I will tidy up my work 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 are followed. I will then handover the milling machine to the assessor, demonstrating the milling machine 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.

Tasl 2 – Practical observation form – work area preparation

Assessment ID	Qualification number
8712-311	8712-31
Candidate name	**Candidate number**
Candidate. B	CG23456
Centre name	**Assessment theme**
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 and calibration dates. They were placed in their working area within reach and a methodical order of use. Technical information, including risk assessment, clean cloths, spill kit, drain trays, and waste bins were 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, ensuring all health and safety requirements were followed before the maintenance activities began. Appropriate warning signs and barriers were used.

Assessor signature	Date
Assessor.1	02/04/2022

Task 2 – Practical observation form – maintenance activities

Assessment ID	Qualification number
8712-311	8712-31
Candidate name	**Candidate number**
Candidate. B	CG23456
Centre name	**Assessment theme**
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 milling machine and obtained permission to start work. The candidate undertook a test run of the milling machine to inform them of the current 'state' of operation. The candidate checked their method statement and technical information as appropriate. The candidate completed this through visual and physical inspections and checked the digital display. They then dismantled the sub-assemblies and lubricated with both grease and oil to the appropriate grade and to the correctly identified components (joints, gears and moving parts). Appropriate PPE was worn at all times. When disassembled, the candidate observed good health and safety techniques relating to storage of removed components and making sure the location was not an obstruction to them or others surrounding them. Overall, the candidate performed initial decommissioning, disassembly, and inspection activities correctly, following a logical and defined sequence of steps.
Fault detection and diagnosis	The candidate approached the fault finding logically, checking the digital display first to gain any information displayed before moving onto other areas of the milling machine. The candidate demonstrated consideration of a range of valid potential causes, before isolating the fault correctly to a gearbox oil drain plug fault. The candidate followed the correct and logical process to remove and replace the components using appropriate methods, techniques and competencies. The candidate tried with various sockets before using a pair of vice grips. Once the drain plug was finger-loose, a drain tray was used to catch the gearbox oil. The candidate

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.*
	removed and fitted a new gearbox oil drain plug and seal. The candidate continued to undertake fault diagnosis checks on the milling machine, discovering that the source of the noise was due to the gearbox being out of tolerance and worn. The candidate did this by following a logical fault diagnosis sequence, inspecting the feed drive motor and checking the motor before moving onto the worn gearing on the shaft. The candidate continued to undertake fault diagnosis checks on the machine, identifying that the leadscrew would not allow backlash adjustment. The candidate then proceeded to completely remove the worm gear shaft and replaced the leadscrew, refitting and adjusting to the correct tolerance values.
Reassembly and recommissioning	The candidate went on to logically reassemble the milling machine using the technical information to reassemble to the correct datum points for the gears/drivers. Torque settings were observed and followed by the candidate using a torque wrench for the required motor assembly bolts. The candidate checked the connections to ensure that they were electrically sound and ensured that everything was replaced correctly. The cutting fluid lines were also checked for kinks, wear and tear and traps. After reassembling the milling machine, the candidate then re-energised the milling machine to test run milling a piece of mild steel. The candidate completed this with the necessary checks to ensure that operational condition had been achieved and the final product was machined to an accurate finish, checking this by eye and with vernier gauges.
Working area	The candidate worked safely and neatly throughout all activities, following all workshop and health and safety requirements. Disconnected wires and components were placed into organised containers which mitigated any trip hazards, kept them tidy and prepared for appropriate waste disposal. All tools and equipment were cleaned and returned to correct storage, waste was disposed of in correct separate bins and the working area left safe, clean and tidy.

Assessor signature	Date
Assessor.1	04/04/2022

Task 2 – Photographic evidence

Photograph 1: Tools, equipment and all relevant technical documentation placed in their prepared working area within reach and methodical order of use. Appropriate barrier and safety signage in place.

Photograph 2: Photographic evidence showing the condition of the full milling machine prior to any work being carried out. The candidate noted the debris and burr around the base of the machine from being previously used.

Photographs 3, 4 and 5: Photographic evidence showing the milling machine subassemblies removed before repair.

Photograph 3: Failed feed nut showing failure due to previous overtightening.

Photograph 4: Removed lead screw placed on a clean and clear working area.

Photograph 5: Lead screw housing after removal which has been swept clean of debris.

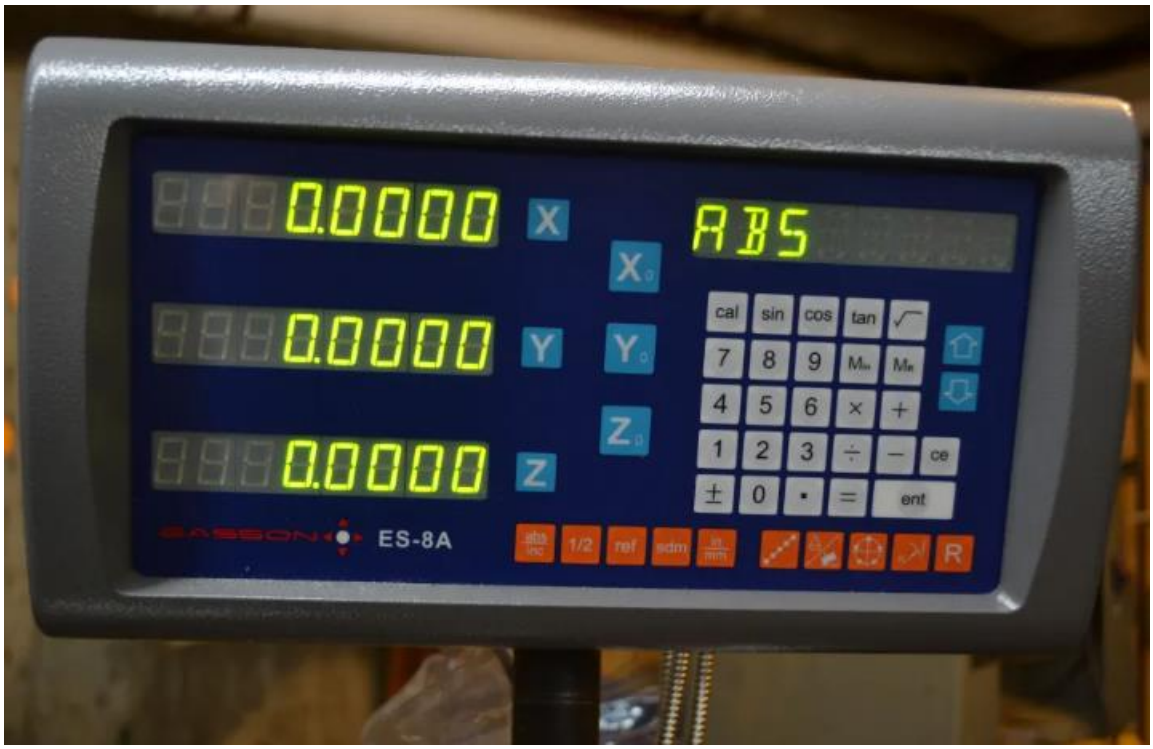
Photograph 6: Photographic evidence showing the wider working area after subassemblies removed from the milling machine, with parts, components and sub-assemblies placed in separate containers not in view, with a clear floor and safety barrier in place. Clean and tidy working area with spare parts organised and on hand.

Photographs 7, 8 and 9: Photographic evidence showing the sub-assemblies after repairs have been completed. The condition of each sub-assembly following repairs show a high degree of accuracy and quality finish to the repair undertaken, components replaced where appropriate, and housing cleaned.

Photograph 7: Correctly refitted and tightened feed nut with no tooling marks and has been thoroughly cleaned.

Photograph 8: final reassembly of feed control wheel, which has been cleaned down.

Photograph 9: Backlash reading showing it has been correctly calibrated within all tolerances and thoroughly wiped clean.



Photograph 10: Photographic evidence showing the full milling machine after the maintenance and service has been completed. The machine and been thoroughly cleaned down, including the removal of debris and burr noted from previous working. The work area has been fully cleaned and tidied and left in an improved condition to that originally found for subsequent users.

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.

Task 3a – Candidate evidence

Task 3a – Technical report

Bridgeport milling machine	04/04/2022

The scheduled maintenance of the milling machine has been fully completed. The maintenance included the inspecting, testing and diagnosing and repairing of any faults found within the system. The inspection techniques completed included sensory checks that included visual and smell, fault diagnostic testing, measurements of machining parameters and finally operational and functional checks of each machinery component. The maintenance completed allowed all the components to be accurately inspected and effectively maintained, however it is to be recommended that the maintenance is conducted on a more regular basis. This is because 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 and poor end product/machinery.

I ensured that I had interpreted the brief requirements by reading through a few times and ensured that I understood the technical specifications, so I knew what to expect from the milling machine operation. I followed the method statement completed in task 2, but made deviations as noted on the modified version when unexpected faults or issues were discovered. This will require a new version to be created to ensure these changes are reflected in future maintenance. I always followed safety precautions, including obtaining a permit to work, fully isolating the system and using LOTO (lock out, tag out) procedures to ensure nobody could be harmed by the machine whilst work was being carried out. I wore safety glasses, boots, gloves and overalls and used a barrier with signage. I used a step ladder whilst working and therefore I needed to use a barrier whilst completing the maintenance, to prevent any incidents or accidents.

During the scheduled maintenance, four faults were discovered, investigated, diagnosed and rectified. These were:

- damaged gearbox oil drain plug – Drain plug replaced with new.
- a damaged and leaking O ring seal – gearbox oil O ring seal replaced with new.
- an excessively worn leadscrew on X axis worm gear – replaced with new leadscrew and adjusted to correct backlash tolerances.
- an excessively worn feed motor gearing – replaced bevel gear in feed motor gearbox.

There was a clattering noise coming from the table feed motor. The half-split technique allowed the root causes to be narrowed down to the exact components and exact issues with them. I proceeded to test each motor and pump for operation, all were operating as expected with exception of the feed motor noise. As part of the maintenance, the isolation of the milling machine was completed before removing any component. To continue with diagnosis the feed motor was required to be removed and inspected before the exact location and fault found, this is due to the complex construction/assembly. I safely removed the feed motor and inspected this to eliminate this from the diagnosis, the motor was in good condition. This left the feed motor, drive system (gearbox) to be at fault. The gearbox transfer's drive through 90 degrees to provide the precise feed speed from the motor to the table.

To rectify the issue, I checked the gearbox assembly by removing the outer casing where I could gain visual access. I discovered that the gearbox bevel gear was excessively worn. I diagnosed this by checking the contact surfaces with engineer's blue. This could have happened due to poor machinery operation speeds selected and would recommend refresher training for all workshop staff as this was causing intermittent failure of the machine and holding up production time.

I replaced the bevel gear with a new one by undoing the grub screw and manipulating the gear off with a puller and a dead blow mallet. On reassembly, the gears required precise assembly ensuring alignment was adhered to. If I had failed to do this, it would have led to inaccurate operation of the milling machine. Worst case scenario could lead to the milling machine tearing through metal objects and creating health and safety hazards and poor-quality finish.

The maintenance schedule was followed ensuring that all the electrical, lubricating and mechanical connections were correct and sound. I found a wire clip was broken and I requested for the part, fitting a new one by removing a self-tapping screw. This could have occurred through environmental exposure of light or heat as it was perished. As part of the maintenance examination, I found the backlash required adjustment. I discovered that the leadscrew on the x axis had excessively worn. This was discovered through using the correct tooling to adjust the backlash and the leadscrew not holding its adjustment. Due to its location to diagnose this further it required machine disassembly and removal of the shaft. This was then removed and upon inspection found to be worn through. A new leadscrew was fitted and lubricated, aligning the keyways. I used the manual to reassemble the whole milling machine with accuracy. This component wears due to it being made of soft material which is prone to wear over time.
The spindle was checked for end float and trueness with a DTI and vernier gauges, all was found to be within acceptable values. The bed was aligned to be straight, level and true using a sprit level, feeler gauges and engineer's square.

The system was then reassembled with wiring and lubricating/cooling connections securely fitted, sub-assemblies put back together, and the casings re-attached. I ensured that the screw/nut fixings were flush with the casings as this provided a neat finish and to help to prevent any snags on clothing or skin during future maintenance.

Once complete, I ran an operation of the milling machine on a block of mild steel. Checks were made and results compared to ensure optimal operation and accuracy of the milling machine, confirming precision assembly and maintenance accuracy. This then deemed

the milling machine safe and operational. All results were logged in the test report so this can be documented and reported back to the supervisor.

The machine was cleaned down to a clean finish ready for use. All tools and equipment were returned to their correct locations. Waste was disposed of as per regulations, and with waste placed into dedicated waste bins for collection by an authorised waste disposal company.

The spare stock that had been taken initially as part of the preparation for the check was returned to the correct location and this was reflected on the stock management sheet as returned. This helps to keep track of what stock has been used and when stock is running low.

Task 3a – Revised maintenance schedule

System:	Findings during maintenance:	Recommendations to seniors:	Justification to seniors:	Recommended next planned maintenance due date:
Bridgeport milling machine	Wire retaining clip worn. Gearbox drain plug rounded and replaced. O ring split and replaced. Worn leadscrew is a wear and tear item, this was broken and replaced. Table feed motor gearbox gearing excessively worn. Bevel gears removed and replaced.	Replace worn wire retaining clip. Due to the amount of excessive wear and tear faults discovered during the planned maintenance activities, I recommend increasing the frequency of planned maintenance to ensure this is properly monitored, wear and tear faults discovered early. Suggest updating this from 12 monthly to 6 monthly intervals. It is also recommended that the milling machine bed is monitored for further faults and check final products for finish and accuracy.	Although more frequent planned maintenance activity will increase the cost to the business, this will be offset through the reduction in system downtime, increase in system efficiency through more regular maintenance as well as reducing the possibility of potential serious health and safety incidents from a poorly maintained machine. Checking end products is important, as this would show whether any machining faults exist, and would indicate areas to be repaired or maintained.	03/10/2022

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.

Task 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 recommends planned maintenance intervals to be reduced and carried out on a 6 monthly basis instead of yearly. 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. B recommendation to increase planned maintenance frequency to 6 monthly but the cost implications to the business will need to be more thoroughly considered. Due to the excessive wear and tear noted in the table feed motor gearbox resulting in gearing excessively worn, I recommend replacing the gearbox drain plug each time planned maintenance is carried out to avoid this happening again as it is a common problem with this type of machine.*

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 enables planned maintenance to be completed at more regular intervals than the current maintenance schedule which will improve system efficiency. The documents produced allow for the maintenance to be recorded clearly.*
How appropriate are the recommended planned maintenance intervals?	*The alteration to the maintenance schedule that is proposed may not be appropriate for the system, its age and use. 6 months may still be too long a period of time for the nature of the milling machine when vibration was noted as this could deteriorate and effect finish/quality of final product if this becomes an ongoing issue.*
What are the implications to the business of the proposed maintenance schedule?	*There is more chance for breakdown as the time between the maintenance is still quite lengthy at 6 months. This could effectively cause more downtime and fault investigation, costing the company more money over time.*
How can the maintenance schedule could be optimised/ improved?	*I agree with candidate. B's recommendation to reduce planned maintenance intervals from 12 monthly but 6 months may still be too long due to the nature and use of this machine. I feel that planned maintenance on the milling machine should be completed every 3 months instead of 6 months which would detect faults as early as possible when they are easier and less costly to address and so reducing system downtime.*

Task 3b – Candidate evidence

Task 3b – Maintenance schedule amended from peer review feedback.

System:	Findings during maintenance:	Recommendations to seniors:	Justification to seniors:	Recommended next planned maintenance due date:
Bridgeport milling machine	Wire retaining clip worn. Gearbox drain plug rounded and replaced. O ring split and replaced. Worn leadscrew is a wear and tear item, this was broken and replaced. Table feed motor gearbox gearing excessively worn. Bevel gears removed and replaced.	Replace worn wire retaining clip. Due to the amount of excessive wear and tear faults discovered during the planned maintenance activities, I recommend increasing the frequency of planned maintenance to ensure this is properly monitored, wear and tear faults discovered early. Suggest updating this from 12 monthly to ~~6 monthly~~ 3 monthly intervals. It is also recommended that the milling machine bed is monitored for further faults and check final products for finish and accuracy.	Although more frequent planned maintenance activity will increase the cost to the business, this will be offset through the reduction in system downtime, increase in system efficiency through more regular maintenance as well as reducing the possibility of potential serious health and safety incidents from a poorly maintained machine. Checking end products is important, as this would show whether any machining faults exist, and would indicate areas to be repaired or maintained.	03/07/2022

Justification for changes:

From the peer review feedback, it was highlighted that 6 months is still a long interval given the possibility of safety issues from a failing machine due to excessive wear and tear because of the nature of the machine and consistent use. With consideration of the feedback, it has been decided that the proposed changes to the maintenance should be increased further from my original recommended 6 monthly to 3 monthly. This will reduce the likelihood of safety incidents, reduce machine downtime and increase system productivity/efficiency which will offset the additional cost of more regular planned maintenance. The feedback was considered and actioned as the points that were made by peers were valid and correct.

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.

Task 4 – Candidate evidence

Task 4 – Handover documentation

Bridgeport Milling machine – Test Record - completed 04/04/2022			
Steps to follow	**Checked**	**Repaired / method used to repair**	**Comments**
Cutting fluid replaced and tank cleaned	✓	✓ Drained, cleaned and replenished.	PH checked with dip. 9.5 PH reading.
Cutting fluid supply pipes checked for cleanliness	✓		Pipes in good condition all fluid flows freely, no blockages.
Gearbox oils drained, inspected and replenished	✓	✓ No excessive metal filings present, oil clearly used and dirty. Filled till level gauge indicated the correct level.	Mill gear EP220 used.
Fluid levels checked	✓		All levels correct on visual float.
Check all electronic connections are sound	✓		All electronic connections are sound no signs of wear and tear present.
Visual check of wires	✓	✓ 1 wire retaining clip very worn and requires future replacement.	No wires fouling machinery.
Check for leaks	✓	✓ Gearbox O ring split. Replaced with new seal and oil drain plug due to being rounded. Leaks checked when machine running post repair.	New parts fitted.
Visual inspection for any defects	✓	✓	N/A

Motor and pumps	✓		All working correctly. Vibration felt on table – investigate.
Noises and vibrations	✓	✓ Noise present (chattering) from feed motor when speed is + 90 fpm (feed per min) HSS (High Speed Steel) tooling used. Upon investigation the feed motor gears have excessive backlash in gearbox with teeth excessively worn. Gearbox housing dismantled, motor removed for access, grub screw removed from shaft, bevelled tooth gear removed from shaft. Replaced bevel toothed gear with a new one checking dimensions (teeth/diameter), fitting new grub screw. Relocate motor with shaft into gearbox – checking backlash against technical information.	Vibration noted when test running machine with mild steel, finish impaired.
Spindle for radial or end play	✓	No excessive play or wear, used DTI gauge and vernier to double check measurements.	Within tolerance.
Bed for level	✓	✓ Minor adjustment made turning the levelling screws until the bubble in the level is centred.	Level and true.
Backlash adjustment	✓	✓ Adjusted using extra-long reach screwdriver, X axis leadscrew replaced due to being broken.	X axis leadscrew renewed.
Check feeds if auto	✓	Correct and within tolerance after gearing replaced – see attached technical document for values.	Within tolerance.
Table saddle checked for clearance/condition	✓	Table saddle (both axis) checked for clearance with feeler gauges.	Within tolerance.

Updated Maintenance Schedule				
System:	**Findings during maintenance:**	**Recommendations to seniors:**	**Justification to seniors:**	**Recommended next planned maintenance due date:**
Bridgeport milling machine	Wire retaining clip worn. Gearbox drain plug rounded and replaced. O ring split and replaced. Worn leadscrew is a wear and tear item, this was broken and replaced. Table feed motor gearbox gearing excessively worn. Bevel gears removed and replaced.	Replace worn wire retaining clip. Due to the amount of excessive wear and tear faults discovered during the planned maintenance activities, I recommend increasing the frequency of planned maintenance to ensure this is properly monitored, wear and tear faults discovered early. Suggest updating this from 12 monthly to ~~6 monthly~~ 3 monthly intervals. It is also recommended that the milling machine bed is monitored for further faults and check final products for finish and accuracy.	Although more frequent planned maintenance activity will increase the cost to the business, this will be offset through the reduction in system downtime, increase in system efficiency through more regular maintenance as well as reducing the possibility of potential serious health and safety incidents from a poorly maintained machine. Checking end products is important, as this would show whether any machining faults exist, and would indicate areas to be repaired or maintained.	03/07/2022

Justification for changes:

From the peer review feedback, it was highlighted that 6 months is still a long interval given the possibility of safety issues from a failing machine due to excessive wear and tear because of the nature of the machine and consistent use. With consideration of the feedback, it has been decided that the proposed changes to the maintenance should be increased further from my original recommended 6 monthly to 3 monthly. This will reduce the likelihood of safety incidents, reduce machine downtime and increase system productivity/efficiency which will offset the additional cost of more regular planned maintenance. The feedback was considered and actioned as the points that were made by peers were valid and correct.

Maintenance log

Milling machine type:	Bridgeport
Milling machine 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. B	Scheduled maintenance and intermittent fault diagnosis.	The milling machine was showing signs of gearbox oil leakage. The drain plug was rounded and the sealing O ring split, both items replaced with new. The maintenance tasks were completed to include the backlash adjustment, replacing the X axis leadscrew due to being excessively worn. Table feed gear box noise, bevel gear to be excessively worn. Gearbox dismantled to replace the worn bevel gear. Electric wire retaining clip worn, recommend replacement with new.	Y X axis leadscrew. Gearbox drain plug. Split drain plug sealing ring. Feed drive motor gear box bevel gear replaced.	*Assessor. 1*	03/07/2022	Planned maintenance has been completed. 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 log				
Date:	**Checking of documentation performed by:**	**Are diagrams and specifications up to date?**	**Are risk assessments in date and applicable to the task?**	**Person to revise any issues with diagrams and specifications:**
03/04/2022	Candidate. B	Yes, most up to date diagrams and specifications are being used. V2.1	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, they would have been relayed to supervisor who would then contact the document controllers as per chain of command.

Task 4 – Practical observation form – handover meeting

Assessment ID	Qualification number
8712-311	8712-31
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 explained and justified the actions taken to rectify the faults found. System functionality was demonstrated clearly and in detail, using the correct technical terminology for each part of the system. The candidate demonstrated excellent communication skills using accurate technical terminology appropriate to the 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 of increasing frequency of maintenance and the candidate explained they chose to not include any changes because of this concern as in the long run increasing the maintenance intervals and fault prevention would be less costly than reactive maintenance and potential increased machine downtime. They also explained their decision to disregard the suggestion of replacing the gearbox drain plug each time planned maintenance is carried out as being unnecessary due to unlikelihood of this being a regular failure and should only be replaced when needed because of failure. The candidate demonstrated excellent communication skills using accurate and consistent technical terminology that was fully appropriate to the audience. 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. Overall, the handover was complete, comprehensive, and used excellent communication skills.

Assessor signature	Date
Assessor.1	04/04/2022

Candidate Record Form (CRF) – Mechanical (8712-311)

Planning and preparation									
Preparation									
	Band 1			**Band 2**			**Band 3**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Mark 8	Notes and justification: Based on the evidence presented, the work aligns with the descriptors of mid Band 3: • A comprehensive range of materials, components, and resources has been selected, with detailed evaluation of their working condition, serviceability, and feasibility. • Thorough consideration has been given to the condition, quality, and performance of tools and equipment through completing a comprehensive range of preparatory checks. • The work area has been prepared with clear consideration of the prepared method statement and workflow, and completed calibration checks have been conducted on most selected tools and equipment.								

Systems and components											
Inspection and testing											
	Band 1				**Band 2**				**Band 3**			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Mark 8	Notes and justification: Based on the evidence provided, the performance generally meets most of the criteria for Band 2 There is a thorough and comprehensive understanding demonstrated in the selection and execution of inspection and testing methods. The choice of test and measurement equipment is appropriate, set up correctly, and utilized with precision, reflecting a strong grasp of the required techniques. The interpretation and application of parameters and tolerances are clear, showing a keen understanding of the relevant standards and requirements. Most units of measurement and calculations are used appropriately and there is a notable degree of accuracy in their application – which starts to look like band 3. In evaluating outputs, data, or readings, there is an attempt to compare them with manufacturer's specifications. However, there is room for improvement as discrepancies are not always identified. Some recording procedures are followed, indicating a basic understanding of documentation requirements, although this aspect could benefit from further refinement. There are some areas that are slightly stronger than band 2 and some areas where there are gaps – overall the evidence represents top marks in band 2.											

Working with faults									
Detection and diagnosis									
	Band 1			**Band 2**			**Band 3**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Mark 8	Notes and justification: Based on the evidence presented, the performance satisfies Mid Band 3 criteria: Thorough fault detection and diagnostic techniques were carried out systematically and logically, demonstrating a very good understanding and application of fault finding. All four faults were correctly diagnosed using a range of fully appropriate fault detection and diagnostic techniques. These were performed with accuracy and precision. Some diagnostic and measurement information was used to determine the causes of the faults and to create a limited schedule of tasks for reactive measures.								
Resolution									
	Band 1			**Band 2**			**Band 3**		
	1	**2**		**3**	**4**		**5**	**6**	
Mark 5	Notes and justification: Based on the evidence presented, the performance aligns with the descriptors for Band 3 with some alignment to band 2 performance. While resolution methods have been identified, there's some room for improvement in their effectiveness. The reference to manufacturer's specifications is not as thorough as it could be and there's a cursory consideration of recording procedures Three identified faults have been addressed and repaired to a good standard. There is clear evidence of consideration for timeframes, ensuring timely completion without compromising on quality or safety standards. The processes followed in the fault repair demonstrate a systematic approach, though there's potential for enhancement to achieve higher efficiency and effectiveness and higher marks in band 3. Additionally, the calibration of machine components has been completed and are operating within the specified tolerances. Ongoing monitoring and fine-tuning may be necessary to maintain optimal performance and ensure long-term reliability. Overall the evidence meets lower band 3 – 5 marks								

Reviewing and reporting						
Reviewing						
	Band 1		**Band 2**		**Band 3**	
	1	**2**	**3**	**4**	**5**	**6**
Mark 5	Notes and justification: The evidence generally meets band 3. , The modifications made to the maintenance processes and procedures demonstrate alignment with the band 3 descriptor. The reasoning provided for these changes is clear an appropriate date has been set for the next planned maintenance activity. To score higher marks in the band, it would have been beneficial to cross-reference and confirm the maintenance intervals with the manufacturer's recommendations to further enhance the credibility and effectiveness of these modifications. This would add an extra layer of validation and ensure that the maintenance activities are aligned with industry best practices and standards. In instances where no improvements or adaptations have been implemented in the maintenance processes and procedures, the provided reasoning is detailed, thorough, and justifies the decision-making process effectively. However, to strengthen this aspect further, it would be advantageous to include comparative analyses or benchmarks that support the rationale behind maintaining the existing procedures without changes. Overall, the evidence meets most of the criteria for Band 3, with some areas that could have been improved so it is lower marks within that band.					

Internal assessor signature	**Date**

Total
***/90**

* Please Note that the Total Mark (90) applies to the full assignment including all Assessment Themes

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About City & Guilds

Since 1878 we have worked with people, organisations and economies to help them identify and develop the skills they need to thrive. We understand the life changing link between skills development, social mobility, prosperity and success. Everything we do is focused on developing and delivering high-quality training, qualifications, assessments and credentials that lead to jobs and meet the changing needs of industry.

We work with governments, organisations and industry stakeholders to help shape future skills needs across industries. We are known for setting industry-wide standards for technical, behavioural and commercial skills to improve performance and productivity. We train teams, assure learning, assess cohorts and certify with digital credentials. Our solutions help to build skilled and compliant workforces.