T-LEVELS | Institute for Apprenticeships & Technical Education

T Level Technical Qualification in Maintenance, Installation and Repair for Engineering and Manufacturing (8712-31)

Maintenance Engineering Technologies: Mechanical (311)

Guide standard exemplification material

Distinction – Sample 2022

First teaching from September 2022
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City & Guilds | eal

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1.1 Jan 2023	Minor typographical amendments	Through document

Contents

Introduction

The sample assessment materials within this document refer to the Maintenance engineering technologies: Mechanical Occupational Specialism assignment. The aim of these materials is to provide centres with examples of knowledge, skills and understanding that attest as examples of a distinction grade. The examples provided do not reflect all evidence from the sample assignment as the focus of this material is the quality and standards that need to be achieved rather than the volume of exemplar evidence provided. However, the examples provided are representative of all tasks in the sample assignment. The evidence presented here has been developed to reflect a distinction grade within each task but is not necessarily intended to reflect the work of a single candidate. It is important to note that in live assessments a candidate's performance is very likely to exhibit a spikey profile and the standard of performance will vary across tasks. A distinction grade will be based on a synoptic mark across all tasks.

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

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

In this GSEM there is candidate evidence from:

- Task 1
- Task 2
- Task 3
- Task 4

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

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

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

Grade descriptors

To achieve a distinction, a candidate will typically be able to:

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

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

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

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

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

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

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

Task 1 – Plan 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.

Candidate evidence

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

Resources The following resources will be required to undertake the required maintenance activities.		
Physical resources (tools/equipment) *The following will be needed to undertake the maintenance activities.*		
	Quantity	**Purpose and justification**
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.

Commentary

The candidate has interpreted the requirements of the brief well, creating a comprehensive list of resources that demonstrate an excellent knowledge and understanding for the maintenance process and the task requirements. The justifications provided for each requirement and resource listed are clear and demonstrate logical thinking and understanding of the maintenance process. For example, conducting the half split technique will ensure the process can be broken down and checked section by section, narrowing down location of any faults and the root causes.

The candidate has identified the components that may be needed to support maintenance of the milling machine as well as the tools and equipment that would be required to install, remove, repair and replace, ensuring activities can be completed efficiently, pre-empting any issues to reduce system downtime. The justifications provided are detailed, allowing the candidate's knowledge, and understanding of the process to be showcased.

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

The candidate has accurately listed all appropriate elements of PPE required for the tasks, demonstrating exemplary safe working practices and understanding of the Health and Safety at Work Act when completing maintenance activities.

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

Commentary

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

The candidate has thoroughly considered and identified a comprehensive range of hazards and risks associated with the maintenance activities on the milling machine to ensure safe working is followed. They have categorised each element of the activities and identified each hazard for each element, showing a thorough understanding and awareness of health and safety working practices to ensure the safety of themselves and others. The candidate has accurately labelled the likelihood and severity for each risk and hazard.

Control measures are detailed, and the candidate has considered a wide variety of scenarios and situations that may arise, demonstrating thorough knowledge and understanding for the process and the activities to be completed. The candidate displays comprehensive knowledge for risk mitigation techniques. For example, cleaning off the machine for burr or metal debris and the broad statement of working with the correct gloves when working in the high debris built-up area (table). This demonstrates that cleaning it down before work is not enough, by always wearing gloves when working in this area mitigates the risk.

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.

Commentary

The candidate has set out a detailed method statement, demonstrating logical thinking and planning. The way the method statement is set out provides a comprehensive guide for the candidate to follow to complete the maintenance activities. Steps are detailed without any stages assumed and would allow the process to be easily followed correctly by a third party. For example, the knowledge and understanding needed to undertake alignment marking and datum setting during reassembly. The candidate has used relevant and accurate technical terminology throughout their method statement. They have demonstrated understanding of the different elements of the system, processes and regulations that impact the work undertaken. The candidate has considered and referred to a range of regulatory requirements showing their knowledge and understanding of compliance with workplace practices, such as checking the condition of tools, equipment (PUWER) and PPE (HASWA) before beginning the task.

The candidate has provided detailed justifications for most of their proposed actions which shows thorough planning and preparation skills for the maintenance activities to meet the requirements of the brief. For example, the highlighting of components needing to be cleaned and then regreased before reassembling the milling machine, why this is important to do and ensuring that this step is part of their planning.

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)

Candidate evidence

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.

Commentary

The candidate has completed a comprehensive test record that provides clear detail of the steps taken to set up and complete the testing process and of the remedies taken for almost all steps of the testing. For example, details provided of the repair and methods used for the noises and vibration includes the feed speed at which these were identified and each sub-assembly and components investigated for the root cause of this issue.

The candidate has followed a clear and logical process to complete all stages of testing utilising their findings at each step to ensure all tests are fully completed and issues rectified. For example, when testing the motor and pumps, vibration on the table was felt so the candidate then moved on to investigating this vibration next, finding the feed motors had excessive backlash due to the gearbox teeth being excessively worn.

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.

Commentary

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

The candidate has completed the control documentation accurately and with clear and relevant detail, including the diagram and specification version number currently in use.

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 it 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.

Commentary

The candidate has clearly annotated their method statement at the intervals when the scope of work needed to change from the planned method statement. The annotations provided are very detailed, and specifically identify the steps taken and the reasons for taking these. This shows the candidate's ability to recognise where changes needed to be made to the planned maintenance from interpretation of fault detection results and to react appropriately to unplanned situations encountered. For example, upon checking the feed the candidate discovered the root cause of the noise and vibration found from excessive wear to the gearbox gearing and so able to resolve this appropriately.

The candidate has shown understanding of how both visual checks and measurement-based testing can result in discovery of unexpected issues and has shown how their planning has changed as a result. They have demonstrated logical thinking by realising that they needed to repair the leadscrew before being able to adjust backlash to the correct tolerance values.

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

Commentary

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

Resources were placed in the working area with consideration of the prepared method statement, demonstrating exemplary understanding of work area preparation and how this can ensure safe and efficient working throughout.

2. Practical observation form – maintenance activities

Assessment ID	Qualification number
8712-311	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 removed and fitted a new gearbox oil drain plug and seal. The candidate continued to undertake fault diagnosis checks on the milling machine,

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.*
	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

Commentary

The candidate demonstrated that they were able to interpret requirements and perform maintenance and fault-finding tasks in line with the requirements of the brief. For example, checking the digital display to gain any further fault diagnosis information before conducting any other inspection or testing techniques.

The candidate was able to demonstrate maintenance techniques showing excellent hand skills and correct use of tools and equipment, ensuring the maintenance was completed to a high standard. For example, when adjusting the backlash an extra long reach screwdriver

was used with a torch for accuracy. Also, when trying to remove the drain plug, various different tooling and techniques were used before using vice grips.

The candidate demonstrated efficient use and application of test equipment to complete the calibration correctly, demonstrating ability to interpret the calibration requirements and documentation which resulted in milling machine accuracy. The candidate paid special attention to the datum marks when reassembling which demonstrates attention to precision, along with running a final milling exercise to confirm the alignment and precision of the milling machine.

The candidate demonstrated efficient use and application of test equipment to complete both initial and final functional tests accurately. Appropriate measurements were accurately taken which supported the fault diagnosis and repair and confirmed the system was ready to be safely re-energised.

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.

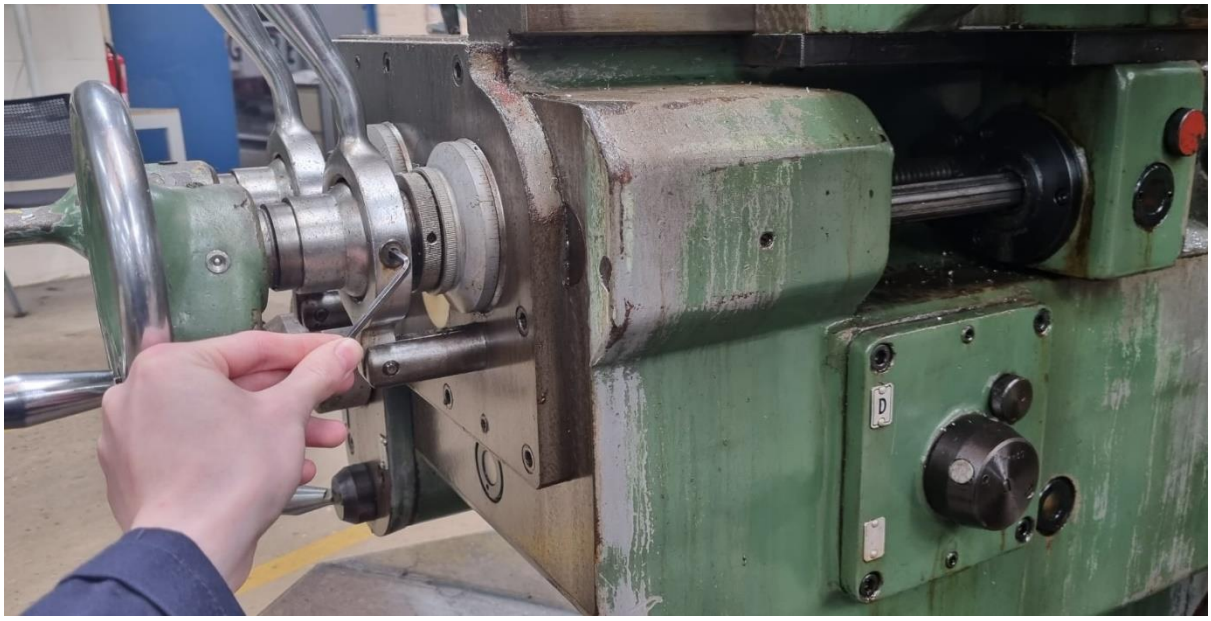
Photograph 5: Lead screw housing after removal which has been swept clean of debris.

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.

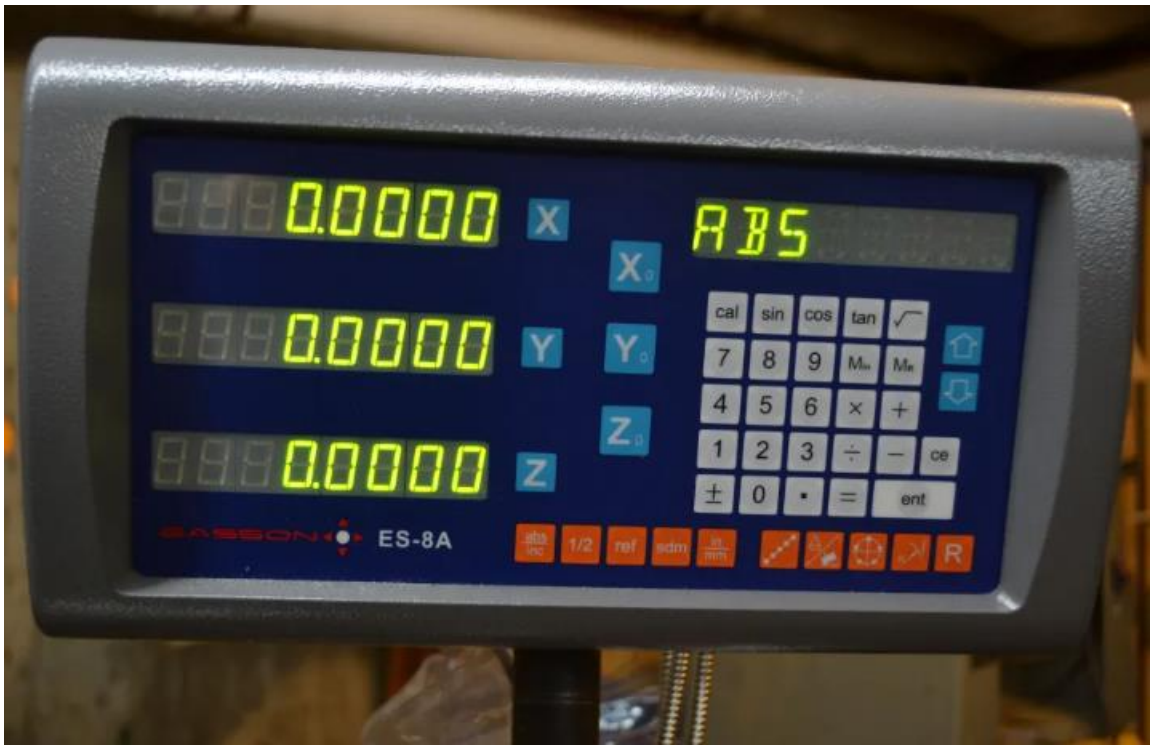
Photographs 7, 8 and 9: Photographic evidence showing the sub-assemblies after repairs have been completed. The condition of each sub-assembly following repairs show a high degree of accuracy and quality finish to the repair undertaken, components replaced where appropriate, and housing cleaned.

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.

Candidate evidence

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.

Commentary

The candidate has analysed and reviewed the maintenance and the issues that were found, providing a recommendation on how this can be improved through explaining that some issues may have been prevented had the system been inspected sooner. For example, the gearbox bevel gear was identified as being excessively worn which could be due to poor machinery operation so the candidate has recommended refresher training for workshop staff which would reduce how quickly the bevel gear wears down.

The candidate has stated the fault-finding and testing methods that were applied and explained how these were used to aid with the locating and diagnosing of the faults. For example, the candidate both identified and diagnosed a worn feed motor gearing, using fault diagnosis methods to determine the cause of the fault. The candidate has explained clearly how the issues were then rectified showing a comprehensive knowledge of the maintenance and fault resolution processes.

The candidate has demonstrated thorough understanding of test reports and their purpose by reviewing and analysing the actions taken and providing clear recommendations for future actions. For example, recommending staff training to prevent further faults and further improve health and safety outcomes.

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

Commentary

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

The candidate has provided a detailed justification for increasing the frequency of scheduled maintenance activities which considers the effects on potential downtime, cost of replacement and safety. For example, showing understanding that a poorly maintained machine could cause potential health and safety incidents to the operator from excessively worn components.

Task 3b – Peer review

(Assessment themes: Reviewing and reporting)

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

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

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

3b. Completed peer review forms

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

Question	**Feedback**
How well does the schedule enable planned maintenance activities to be performed and recorded over time?	*The schedule 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.*

Candidate evidence

3b. Maintenance schedule amended from peer review feedback.

System:	Findings during maintenance:	Recommendations to seniors:	Justification to seniors:	Recommended next planned maintenance due date:
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.

Commentary

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

The candidate has taken on board the peer review feedback and implemented changes where they agreed it was appropriate to further improve safety and reduce the possibility of

downtime. The candidate has provided clear justifications for the changes made, giving detailed reasoning for their decision and recommendations. For example, showing understanding that increasing the regularity of the planned maintenance intervals would increase initial maintenance costs, but through ensuring a well-maintained machine it would reduce machine downtime and increase productivity and efficiency – saving cost over time. This demonstrates a clear understanding of the maintenance process and cost implications.

Task 4 – Complete handover

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

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

- handover documentation.

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

- assessor observations of the handover meeting.

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

- video evidence showing the handover meeting.

Candidate evidence

4. Handover documentation

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.

Commentary

The candidate has ensured to hand over all relevant documentation required, including the completed test record, maintenance log, controlling of documents log and updated maintenance schedule, and ensuring to obtain a signature confirming that work has been completed. This shows comprehensive understanding of the importance of thorough documentation and recording procedures as well as the requirements of handover procedures.

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

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.*
	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

Commentary

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

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

The candidate clearly addressed the revised maintenance schedule and the peer review feedback received, explaining some feedback they chose to dismiss as it was unnecessary. For example, dismissing the suggestion to change the gearbox drain plug at each planned maintenance interval instead of waiting for it to fail, the candidate understood and justified that this was unnecessary because it is not a common failure and would add additional costs to the business.

The T Level is a qualification approved and managed by the Institute for Apprenticeships and Technical Education.