



Mapping Exercise

Mechanical Technician (Underground)

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Introductions

This document has been produced to examine how statements within the National Occupational Standards (NOS) can be used to develop the content that could form a common training standard for mechanical technicians across the UK mining sector. The following standards have been considered as part of developing this approach.

Module Title	Original NOS Reference	UK Standards Reference
Confirm Work Activities and Resources for the Work	MT8	PROMT8
Using Engineering Drawings and Documents in Maintenance Activities	MT9	PROMT9
Identify and Address Mine Engineering Health and Safety Hazards and Risks	MT16	PROMT16
Operate Safely in the Mine Environment	MT17	MPQVG01
Confirm to Efficient Work Practices	MT18	MPQVG02
Handing Over and Confirming Completion of Maintenance Activities	MT19	PROMT19
Carry Out Fault Diagnosis on Mechanical Equipment	MT20	SEMEM305
Maintaining Mechanical Equipment	MT21	PROMPR23
Restoring Mechanical Components to a Useable Condition by Repair	MT22	PROMT22
Producing Replacement Components for Maintenance Activities	MT23	PROMT23
Carrying Out Preventative Planned Maintenance on Mechanical Equipment	MT24	SEMEM309
Working Safely on Mechanical Equipment in Mines	MT25	PROMT25

The tables contained within this document have aimed to:

1. Use the knowledge statements from the NOS to inform a wider content for any training programme.
2. Use the performance statements to start to inform a structured approach to assessment.

There are some elements following the initial review that are not considered within the existing NOS. Suggestions have been included for additional content that would improve the technical capabilities of the candidate. The table below provides detail of the additional units being suggested:

Proposed Additional Modules		
Module Title	Original NOS Reference	UK Standards Reference
L3 BTEC Unit - Electro-Pneumatic and Hydraulic Systems	K/600/0204	NA
Installation of Mechanical Equipment	SEMIC 305	NA

Once the content of this document has been agreed by the sector it is suggested that:

1. A structured portfolio is developed that covers the knowledge elements.
2. The portfolio is structured around a reference document that would allow the apprentice/ mechanical technician to easily reference completed elements.
3. A structured skills development programme is developed that covers the key performance statements.
4. A structured assessment is constructed for each of the elements to allow the assessment of the performance elements.

Disclaimer

The **Mining Qualification Committee** (MQC) has developed and reviewed the training and assessment material.

MPQC have provided the accreditation for the training and assessment material.

MAUK have published the training and assessment material and provided access for the underground mining sector.

It remains the responsibility of the **mine operator** to verify the training and assessment material is suitable for their circumstances and application.

Knowledge Element

MPQVG01 (MT17) – Operate Safely in the Mine Environment

This module can be satisfied by the common induction module (working safely and efficiently in the underground environment).

MPQVG02 (MT18) – Confirm to Efficient Work Practices

This module can be satisfied by the common induction module (working safely and efficiently in the underground environment).

PROMT8 (MT8) – Confirm Work Activities and Resources for the Work

PROMT8 (MT8) – Confirm Work Activities and Resources for Work		
Knowledge Statement		Elements
K1	How to identify the work activities.	Understand how potential work activities are identified.
		Understand how the work activity is recorded.
		Can outline the planning process to ensure that work activities are suitably co-ordinated.
		Can define how work is allocated as part of the deployment process.
K2	How to assess the resources needed from the information available.	The process for identifying the number of people required to complete a task.
		The process for identifying if there are any components/ parts that are required to complete a task.
		The process for identifying if there are specialised tools required to complete the task.
		The process for identifying the need to have access to specific plant/ equipment/ skills to complete the task.
K3	How to prepare a work programme.	How to use the information in K2 to generate a method of work for completing the tasks.
		How to extend the work being allocated to cover a shift or meet specific organisational objectives.
K4	How to obtain clarification and advice where the resources required are not available.	The organisational process to escalate where the element identified in K2 above are not available.
K5	Valuation of the work activities against project requirements and the requirements of significant external factors.	How progress is against the plan for the day.
		How progress is measured against any overarching project plan.
		How to understand if there are other elements/ functions that may impact delivery of the tasks or plan.
		How to use the process to agree priorities (based on safety/ expediting delivery/ minimising operational impact).
		Shift Handover Reports.

K6	How to identify which work activities influence each other.	How dependencies are identified within the planning process.
		How the dependencies are used to influence the planning of resources and activities.
K7	How to determine how long each work activity will take and the sequence of activities. Alterations to the work programme.	Understanding of any plant or equipment not being available including pumps, and environmental monitoring equipment which could affect the safety of the mine.
		Ability to modify/ amend the work to prevent an unsafe condition.
		Methods of evaluating progress against plan and rescheduled priorities to ensure the delivery.
K8	How to identify alterations to the work programme to meet changed circumstances.	Identified in K7 above.
		Identify the management of change process used within your organisation.
K9	How to assess the contractual/ work effects resulting from alterations to the work programme.	Suggested that this may be above the technician level, and it is not included within the proposed structure.
K10	How to justify to decision makers the effects resulting from alterations to the work programme.	Identified in K7 above.

PROMT09 (MT9) – Using Engineering Drawings and Documents in Maintenance Activities

PROMT09 (MT9) – Using Engineering Drawings and Documents in Maintenance Activities		
Knowledge Statement		Elements
K1	The information sources used for the drawings and specifications that you use in your work activities.	Knows where to find the information on site.
		Understands how to engage with manufacturers and suppliers to get relevant up to date information.
		Knows how to book out (and replace the information) including any referencing systems.
		Knows what a hydraulic and pneumatic schematic diagram is and how it is used.
		Knows what a hosing drawing is and how it relates to the machine/ equipment.
		Knows how manufactures provide updates, and how these are utilised as part of modifying and updating machinery and equipment.
		Knows what a schematic diagram is and how it is used.
		Can differentiate between hydraulic and pneumatic circuits.
		Knows how to use other, none paper based sources of information.
K2	How drawings and documents are obtained, and how to check that they are current and valid.	Can outline what the process is at their site for the control of documents and the document management system that is used.
		Knows what to do if the document available within the document management system is not to the current standard or specification.
		Understands the organisational arrangements for document and version control.
K3	How to use other sources of information to support the drawings (such as electronic component pin configuration specifications, standard reference charts for limits and fits, tapping drill reference charts, cable current carrying capacities, thread reference tables).	See K1 above.
K4	The procedures for reporting discrepancies in the drawings or	See K2 above.

	documents and for reporting lost or damaged drawings/ documents.	
K5	Care and control procedures for the drawings and documents, and the importance of returning them to the designated location on completion of the work activities.	See K1 above.
K6	The basic drawing conventions that are used, and why there needs to be different types of drawings.	See K1 above. Knows the various symbols that may be used to indicate elements or components within the mechanical system. Knows how hose sizes, connections, valves, pressure rating and other equipment are identified on drawings.
K7	The types of drawings used, and how they interrelate (such as isometric and orthographic, first and third angle, assembly drawings, circuit and wiring diagrams, block, and schematic diagrams).	See K1 above. Other content within this section is self-explanatory.
K8	Imperial and metric systems of measurement, tolerancing and fixed reference points.	Can use suitable scales to interpret dimensions from an engineering drawing. Can convert the measurement from imperial to metric and vice versa. Understands the principles of engineering tolerances when it comes to measurement and construction and why observing these tolerances are important to the safety, quality, and reliability of the finished product.
K9	The meaning of the different symbols and abbreviations found on the drawings that you use (such as surface finish, electronic components, weld symbols, linear and geometric tolerances, pressure, and flow characteristics).	See K6 above. Understands the principle of CE marking. Understands the principle of UK Certifications marking. Understands markings relating to protection levels (for example ATEX). An understanding of other standards (for example ISO/ British Standards/ EN Standards etc.).
K10	How damage or graffiti on drawings can lead to scrapped work.	Understands the principle of controlled copies of drawings, and any modifications written on drawings may fall outside the required safety/ quality requirements. Understands how working to uncontrolled drawings could potentially lead to aborted work and lost dates.

K11	The extent of your own responsibility, when to act on your own initiative to find, clarify and evaluate information, and to whom you should report if you have problems that you cannot resolve.	Understands the limit of their authority when it comes to varying from the standards.
		Understands the reporting procedures to make sure that any work that varies from the standards are adequately captured within the document control and asset maintenance systems.
		Understands the escalation procedure when it comes to seeking guidance.
		Understands the hierarchical structure within the engineering function and how issues or concerns are escalated.

PROMT16 (MT16) – Identify and Address Mine Engineering Health and Safety Hazards and Risks

PROMT16 (MT16) – Identify and Address Mine Engineering Health and Safety Hazards and Risks		
Knowledge Statement		Elements
K1	Definitions of hazard, risk, accident, danger.	<i>The statement is self-explanatory (expand within the portfolio questions).</i>
K2	Workplace monitoring and hazard identification methods, e.g., formal and informal health and safety inspections, surveys, and audits.	Can define how the major mining hazards that exist within the workplace are monitored and reviewed.
		Can define how the information relating to the management and performance of the major hazard control is communicated.
		Understands the steps that need to be taken to control and reduce the risks.
		Can define how workplace inspections are completed to comply with the requirements of the Mines Regulations 2014.
		Can define how departmental inspections of plant/ equipment (and other items) is conducted and recorded.
		Understands how the information from departmental inspections is used to drive continuous improvement.
K3	Basic procedures for carrying out health and safety risk assessment.	Can identify the organisational procedure for carrying out a formal risk assessment.
		Understands the hierarchy of controls and how these are applied to a risk assessment process.
		Understands the process for evaluating/ scoring the risk and how this process is used to determine the level of risk following the application of controls.
		Understands where a point of work risk assessment may be used in their organisation, and the limits to which these may be applied.
		Understands the legislative requirements for undertaking risk assessments under "The Management of Health and Safety at Work Regulations 1999".
		Organisational arrangements for escalation, should the assessment not suitably reduce the risk.

K4	Organisational arrangements for identification and reporting of hazards and risks.	What method is used within the mine to formally identify and report hazards (in compliance with the Mines Regulations 2014).
		How does the mechanical department identify potential risks and ensure that these are reported?
		The actions that you should be taking if you find a safety or operational risk with a mechanical component or system.
		How those hazards and risk are brought to the attention of others within the organisation – how this information is utilised to develop continuous improvement.
K5	The benefits of participation of persons at work.	The statement is self-explanatory (expand within the portfolio questions).
K6	Basic knowledge of the main types of occupational health risk – chemical (toxic, corrosive, dermatitis), physical (noise, dust, temperature, light, vibration, repetitive strain) and ergonomic.	The statement is self-explanatory (expand within the portfolio questions).
K7	Basic knowledge of the main hazards associated with mining (e.g.s. noxious gasses/ unsafe atmosphere, falls of ground, inrush, outburst, plant and machinery including transporting/ winding systems, slips/ trips/ falls, fire, explosions, surface hazards including tips).	See K8 of PROMT10 (different categories of hazards and hazardous situations in mines).
		Outline the major hazards defined within the Mines Regulations 2014 that are applicable to your organisation.
		Outline other hazards that might be present within the work environment, that have the potential for multiple casualties, multiple fatality events if they are not adequately controlled.
		The use of assessment techniques used by your organisations for the major mining hazards.
K8	Hazards and risks arising from plant/ machinery incorrectly used/ installed/ maintained.	The statement is self-explanatory (expand within the portfolio questions).
K9	Industrial Standards relevant to using mechanical systems in mines.	Identify the requirements of the Pressure Equipment Regulations 1999.
		Identify the requirements of the Pressure Systems Safety Regulations 2000.
		Identify the requirements of the Electricity at Work Regulations 1999 (and schedule 1 – items relating to mines).
		Safe Isolation of Plant and Equipment (HSG253).

		Provision and Use of Work Equipment Regulations.
		Lifting Operations and Lifting equipment Regulations.
		Dangerous Substances and Explosive Atmospheres Regulations.
		See K16 of PROMT25 .
K10	Approved codes of practice and guidance for working safely with energy systems in mines.	See K17 of PROMT25 .
K11	How to obtain and use information on plant/ machinery/ equipment (e.g., manufacturers manuals, engineering drawings, specifications).	See K1 of PROMT9 (information sources).
		See K2 of PROMT9 (organisational process for obtaining up to date drawings).
		See K3 of PROMT9 (how drawings/ documents are obtained).
		See K8 of PROMT13 (how to obtain and interpret information).
K12	How the incorporation of commonly used protective devices and correct plant maintenance contribute to the reduction of risks.	Identify the types of protective devices that might be found on pressure systems in a mine.
		For each of the protective devices identified, give an indication of how they reduce the risk to using pressure systems in mines.
		For each of the protective devices listed, identify the typical maintenance requirements to ensure that it is rated correctly and has remained operational.
K13	Safe working practices for yourself to include all systems, procedures, equipment, and materials in use.	See K3 above (risk assessment).
		See K1 of PROMT25 (isolation procedures).
		See K1 of PROMT25 (permit procedures).
K14	Your scope, responsibility, and limitations for dealing with hazards and risks.	See K24 of PROMT25 (responsibilities and limitations).

PROMT19 (MT19) – Handing Over and Confirming Completion of Maintenance Activities

PROMT19 (MT19) – Handing Over and Confirming Completion of Maintenance Activities		
Knowledge Statement		Elements
K1	The health and safety requirements of the area in which the handover is to take place, and the responsibility they place on you.	The organisational procedure for passing on information to an oncoming shift.
		The organisational requirements relating to incomplete work activities and leaving the place safe for the oncoming/ following shift.
K2	The isolation and lock-off procedure or permit-to-work procedure that applies to the equipment being maintained.	See K1 of PROMT25 (isolation procedures).
		See K1 of PROMT25 (permit procedures).
K3	The specific health and safety precautions to be applied during the handover procedure, and their effects on others.	The requirement to identify any specific issues (such as loss of critical protection and safety systems).
		The arrangements for handing over permits and keys for the isolation locks.
		The arrangements for ensuring that on complex, remote isolations all parties are aligned on the status of the work activities.
		Any specific requirements to fence off areas or prevent inadvertent access due to the nature or consequence of the work activities.
K4	The importance of wearing protective clothing and other appropriate safety equipment whilst operating/ using the equipment during the handover operations and where it may be obtained.	Covered in various sections throughout the standards.
K5	The checking process to be followed before handing over the equipment (such as are the safety and quality systems operable, does the equipment function to specification).	The arrangements to verify that the work has been completed to a correct standard before closing up any enclosures.
		The arrangements to verify that all people are clear of the work area before readmitting any energy source.
		The arrangements for ensuring that all tools have been removed and covers replaced before admitting any energy source.
		The requirement to carryout functionality testing to verify the maintenance/ repair/ modification before handing over the plant/ machinery.

K6	The appropriate handover procedure, depending on the maintenance activity carried out (repair, modification, preventative maintenance, scheduled servicing).	See K5 above (the checking process).
		Understands the organisational arrangements, and the difference between functionality testing and the requirement to re-commission a system.
K7	The procedure for involving the appropriate people when operating/ using the equipment.	Understands that as a mechanical technician you may not have the required knowledge or competencies to operate the plant/ equipment.
		Understands how to organise, to have the correct people available, with the right competencies to assist in operating/ testing the plant/ equipment.
K8	The need to highlight, where appropriate, any new, current, or changed operating features of the maintained or installed equipment.	The organisational procedure for managing change, and recording any modifications made to the plant/ equipment or the control systems.
		Understands any paperwork or other reporting that needs to be completed.
K9	The importance of informing the appropriate person of any future maintenance requirements.	The organisational procedure for ensuring that any changes to the maintenance arrangements/ procedures are implemented.
		The organisational arrangements that may trigger a requirement to change or vary the existing maintenance procedures.
		Understands any paperwork or other reporting that needs to be completed.
K10	The need to confirm that the other person understands how to use/ operate the equipment before handing the equipment over to them.	The organisational arrangements to make operators aware of any changes made to the functionality or control of any plant or equipment.
		The organisational arrangements to make operators aware of any changes to operational limits, operating speed, interlocks that may have been used or relied on to govern the operation of the plant/ equipment.
		Understands any paperwork or other reporting that needs to be completed.
K11	The need to ensure that the person you are handing over the	The organisational arrangements that exist between functions for the handover of plant/ equipment following installation.

	equipment to accept that it is in a satisfactory condition.	The organisational arrangements that exist between functions for the handover of plant/ equipment following modification. The organisational arrangements that exist between functions for the handover of plant/ equipment following maintenance. Understands any paperwork or other reporting that needs to be completed.
K12	The organisational documentation procedures to be used with regard to the handover.	See K8 above (highlight change). See K9 above (informing appropriate people). See K10 above (confirmation of understanding). See K11 above (acceptance). Understands the development of commissioning documents. Understands the organisational procedure for completing static commissioning. Understands the organisational procedure for completing dynamic commissioning. Understands the organisational procedure for sign off and handover following static and dynamic commissioning.
K13	How to create and maintain effective working relationships with appropriate people (such as encouraging, helping, politeness, open discussions both ways).	The statement is self-explanatory (expand within the portfolio questions).
K14	The problems that can occur during handover, and how they can be overcome.	The statement is self-explanatory (expand within the portfolio questions).
K15	The extent of your own authority and to whom you should report if you have problems that you cannot resolve.	Define the various levels of authorisation that exist within your organisation. Outline what is required to move between these various levels of authorisation within your organisation. Define your own limitation and responsibilities, in relation to the organisation's scheme.

SEM305 (MT20) – Carrying Out Fault Diagnosis on Mechanical Equipment

SEM305 (MT20) – Carrying Out Fault Diagnosis on Mechanical Equipment		
Knowledge Statement		Elements
K1	The health and safety requirements of the area in which the fault diagnosis activity is to take place, and the responsibility these requirements place on you.	See K1 of PROMT16 (definition of hazard/ risk etc).
		See K2 of PROMT16 (workplace monitoring and hazard identification).
		See K3 of PROMT16 (basic requirements for completing a health and safety risk assessment).
		See K1 of PROMT25 (isolation procedures).
		See K2 of PROMT25 (definitions).
		See K3/ K4 of PROMT25 (permit to work).
		See K8 of PROMT25 (high pressure injuries).
		The dissipation of stored energy within mechanical systems (for example conveyors under tension, drag chains under tensions, weight towers, tensioning devices and lifting and pulling equipment under tension).
		Ensuring plant and equipment that might move under the effect of weight/ gravity is suitably secured to prevent inadvertent uncontrolled movement.
K2	The specific safety precautions to be taken when carrying out fault diagnosis of the specific piece of equipment.	Arrangements to prevent ramps, or other lifting devices from inadvertently lowering whilst work operations taking place.
		See K1 of PROMT25 (isolation procedures).
		See K2 of PROMT25 (definitions).
		See K3/ K4 of PROMT25 (permit to work).
		See K9 of PROMT25 (high pressure injuries/ operation of accumulators).
		See K1 of SEM305 (above).
		Understands the risk from stored pressure sources and the requirement to conduct safe dissipation, even though equipment has been isolated.
K3	The isolation and lock-off procedure or permit-to-work procedure that applies.	
		See K1 of PROMT25 (isolation procedures).
		See K2 of PROMT25 (definitions).
		See K3/ K4 of PROMT25 (permit to work).
		Define any special circumstances that may exist within the organisation for carrying out isolations under fault/ breakdown conditions.
K4	The importance of wearing protective clothing and other	
		The statement is self-explanatory (expand within the portfolio questions).

	appropriate safety equipment (PPE) during the fault diagnosis activities.	
K5	Hazards associated with carrying out fault diagnosis on mechanical equipment (such as moving machinery, handling oils and greases, stored pressure/ force, misuse of tools, using practices or procedures that do not follow laid-down procedures), and how to minimise these and reduce any risks.	Identify the hazards associated with moving plant or equipment and how this would be controlled. Identify the hazards that are associated with the use of oils and greases and how this might be controlled. See K8 of PROMT25 (high pressure injuries). See K9 of PROMT25 (potential injuries from high pressure systems). Identify the hazards associated with tools that are commonly used by the mechanical technician, and how these are maintained, calibrated, used, and stored to minimise the risk. Identify where standard operating practices are found, and the action that the mechanical technician should take if they cannot follow these procedures. Identify the potential risk associated with varying from the standard operating procedure (consider personal as well as risk to others, the equipment, and the mine environment).
K6	Where to obtain, and how to interpret, drawings, specifications, manufacturers' manuals and other documents needed in the fault diagnosis process.	See K1 of PROMT09 (information sources for drawings). See K2 of PROMT09 (ensuring that drawings are current and valid). See K3 of PROMT09 (using other sources of information). See K6 of PROMT09 (basic drawing convention).
K7	The procedure to be adopted to establish the background of the fault.	Can identify the importance of how plant and equipment would normally operate. Can identify where they would get information that relates to the normal operating parameters of the machine and other key components. Review equipment commissioning data/ speaking to the operators. Can define how they would investigate what was happening at the time and what changed to indicate that a fault had occurred, using historical data and information from the operators. Understands how to analyse the evidence that has been collected. Understands the principles of breaking down the fault to try and identify the problem area.

		Understands how to locate and utilise information and manuals provided by the OEM.
		Understands how to identify the component(s), replace and test to prove that the fault has been rectified.
K8	How to evaluate various types of information available for fault diagnosis (such as operator reports, monitoring equipment, sensory information, machinery history records and condition of end product).	See K6 above.
		See K7 above.
		Understands how to validate the information by carrying out test on the systems and components and verify that they are operating within prescribed tolerances.
		See K7 of PROMT25 (tests on mechanical circuits).
K9	The various fault-finding techniques that can be used, and how they are applied (such as half-split, input/ output, emergent problem sequence, six-point technique, function testing, unit substitution, injection and sampling techniques, and equipment self-diagnostics).	Self-explanatory, include these and other techniques within the knowledge section of the portfolio.
K10	How to use various items of test equipment, and how to calibrate it and check that it is free from damage and defects.	Identify the type of test equipment that could be used to identify the flow within a hydraulic/ pneumatic or other circuit.
		Identify the type of test equipment that might be used to identify the pressure in a mechanical circuit.
		Identify the type of equipment that might be used to test the thickness or integrity of metal wear surface or structures.
		Identify how to test if a valve is operating correctly, and the type of test equipment that would be used.
		Identify how the tension with ropes or other systems such as conveyors can be measured.
		Identify how the breaks and fractures within ropes may be tested.
		Identify the use of temperature monitoring or the use of thermal image camera.
		Identify the use of endoscopes, or other devices to allow the examination of internal components.
		Identify the use of tribology to identify potential issues with internal components.
		Outline the principles of non-destructive testing.

		Identify the use of Vibration Analysis to identify potential issues with internal components.
		For all of the above, identify how the instruments are checked to ensure that they have remained in calibration.
K11	How to use various items of test equipment and understand the requirement to calibrate and check that test equipment is free from damage and defects.	See K10 above.
K12	How to evaluate sensory information (sight, sound, smell, touch).	Define how a person's senses may be used to identify potential issues/ faults.
K13	The procedure(s) to be followed for investigating the faults, and how to deal with intermittent faults.	Identify a typical procedure that a mechanical technician might use to identify a fault on plant and equipment used underground.
		Identify how you would make it safe prior to carrying out fault finding techniques.
		For intermittent faults, identify the process that you could use to narrow the fault to an area, a circuit, or an operation.
K14	How to analyse and evaluate possible characteristics and causes of specific faults/ problems.	See K8 above.
K15	How to relate previous reports/ records of similar fault conditions.	See K6 above.
		Identify how you might use information from maintenance systems at the mine, including work and defect history files to assist in locating faults.
		Understands that equipment suppliers may be an additional source of information and may have experienced similar issues on other sites.
		Identify how people with experience of working on similar plant and equipment might assist in the identification of the fault.
K16	How to evaluate the likely risk of running the equipment with the displayed fault, and the effects the fault could have on health and safety, and on the overall process or system.	See K1 of PROMT16 (definition of hazard/ risk etc).
		See K2 of PROMT16 (workplace monitoring and hazard identification).
		See K3 of PROMT16 (basic requirements for completing a health and safety risk assessment).

		For the following type of plant, identify the potential risks of running or operating with a fault present: • Mobile plant fitted with an internal combustion engine. • Plant fitted with high pressure hydraulic and pneumatic systems. • Plant fitted with dust suppression systems. • Plant fitted with ignition protection systems. • Plant with guards not in place or components exposed (this may include such devices as nip guards). • Plant that is susceptible to the ingress of dirt/ moisture. • Plant and equipment that relies on lubrication to maintain the integrity of the systems. • Plant or equipment where bearings have failed or are evidently in the process of failing. • Plant or equipment that uses cooling systems to maintain its integrity. • Operating mineral conveying systems with compromised fastenings (for example mechanical joints on conveyors or links within a chain). • Fault diagnosis on fire suppression and fire deluge systems. • Lifting equipment and hoists. • Man riding equipment. Candidate should include those that are normally present within their areas of responsibility.
K17	How to prepare and produce a risk analysis report (where appropriate).	The use of probabilistic risk assessment to analyse the likelihood and severity of potential failures. Identification of potential problem areas in a report, and the actions required to reduce the likelihood of the event occurring.
K18	How to prepare a report and take follow-up action which satisfies the company policy on concluding fault diagnosis.	Understands the process at the site for reporting the outcome of any fault diagnosis exercise. Understands the process by which additional work actions are registered in the asset maintenance system and these are turned in to work/ follow up actions (including those that require follow up at a future date).

		Identify any additional information that may need to be recorded in your organisation that will inform the costs of ownership of maintenance schedules associated with the operation of various plant and equipment.
K19	The extent of your own authority and to whom you should report if you have problems that you cannot resolve.	See K25 of PROMT10 (responsibilities and limitations).

PROMPR23 (MT21) – Maintaining Mechanical Equipment

PROMPR23 (MT21) – Maintaining Mechanical Equipment		
Knowledge Statement		Elements
K1	The health and safety requirements of the area in which the maintenance activity is to take place, and the responsibility these requirements place on you.	Identify how you make sure that the maintenance activity will not negatively impact on the safety of others in the mine (for example the unplanned stoppage of a ventilation fan).
		Identify how you make sure that the equipment to be worked on is isolated effectively.
		Identify any specific organisational requirements for fencing or creating exclusion zones when certain maintenance activities are taking place.
		See K1 of PROMT16 (definition of hazard/ risk etc).
		See K2 of PROMT16 (workplace monitoring and hazard identification).
		See K3 of PROMT16 (basic requirements for completing a health and safety risk assessment).
		See K1 of PROMT25 (isolation procedures).
		See K2 of PROMT25 (definitions).
		See K3/ K4 of PROMT25 (permit to work).
K2	The isolation and lock-off procedure or permit-to-work procedure that applies.	See K1 of PROMT25 (isolation procedures).
		See K2 of PROMT25 (definitions).
		See K3/ K4 of PROMT25 (permit to work).
		Identify any specific "castell key" type interlock procedures and be able to evaluate if these systems provide adequate isolation.
K3	The specific health and safety precautions to be applied during the maintenance procedure, and their effects on others.	Self-explanatory, include these and other techniques within the knowledge section of the portfolio.
K4	Hazards associated with carrying out mechanical maintenance activities (such as handling oils, greases, stored pressure/ force, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures), and how to minimise these and reduce any risks.	See K5 of SEM305 (hazards associated with fault diagnosis on mechanical equipment).

K5	The importance of wearing protective clothing and other appropriate safety equipment during maintenance process.	See K4 of SEM305 (the importance of wearing protective clothing and other appropriate safety equipment during the fault-finding process).
K6	How to obtain and interpret drawings, specifications, manufacturers' manuals, and other documents needed in the maintenance process.	See K1 of PROMT09 (sources of drawings/ information).
		See K2 of PROMT09 (how drawings/ documents are obtained).
K7	The procedure for obtaining replacement parts, materials, and other consumables necessary for the maintenance activities.	Outline how within your organisation you would obtain replacement parts/ materials and other consumables that were required.
		Outline how these parts/ materials and consumables are reordered to ensure ongoing availability, you should include the role of the mechanical technician.
		Define what is done with the parts/ materials and consumables that have been used or replaced, and how these are recycled or disposed of.
		Identify how parts not used are returned back to stock within your organisations.
K8	Company policy on repair/ replacement of components during the maintenance process.	See K7 above.
		Identify your organisations policy on where new parts are sourced.
		Identify your organisations policy on using OEM sourced components. Understand that when working on safety critical components, the requirement for replacement parts from the original equipment manufacturer (OEM).
		Identify your organisations approach to having exchanged parts repaired (the use of 3 rd party repairs versus OEM).
		Identify how the specification for any repaired component or equipment is developed.
		Identify how any repaired component is signed off as complying with the organisation's specification.
K9	The sequence to be adopted for the dismantling/ re-assembly of various types of assemblies.	See K1 of PROMT16 (definition of hazard/ risk etc).
		See K2 of PROMT16 (workplace monitoring and hazard identification).
		See K3 of PROMT16 (basic requirements for completing a health and safety risk assessment).

		See K1 of PROMT25 (isolation procedures).
		See K2 of PROMT25 (definitions).
		See K3/ K4 of PROMT25 (permit to work).
		See K8 of PROMT25 (high pressure injuries).
		See K1 of SEM305 (energy dissipation).
		Process for dismantling/ reassembly will include:
		• Selection of the right tools. • Creating a clean and tidy work area where components can be laid out. • Using recording techniques such as photographs to record the process. • The use of measuring techniques to verify the status of components as they are removed or assembled. • The cleaning of components to allow inspection during disassembly. • The cleaning of components as part of reassembling and ensuring cleanliness. • Lubrication of components.
		See K1 of PROMT09 (information sources).
		See K2 of PROMT09 (verifying information).
		Understands the requirement of the OEM to provide a technical file and identify its location and content.
		Use technical information, OEM support systems and experience gained by others at the mine to assist in determining the safe sequence of dismantle and re-assembly.
K10	The methods and techniques used to dismantle/ assemble mechanical equipment (such as release of pressures/ force, proof marking, extraction, pressing, alignment).	Outline the various techniques that may be used when dismantling or assembling mechanical equipment, you should include the following in any response:
		• Release of pressure. • Release of force (in springs, belt, or chain tensioning devices). • Proof marking components. • Extraction techniques for bolts, pins, shafts bearing, pullies, and gears. • Installation techniques for bolts, pins, shafts bearing, pullies, and gears. • Methods of verifying alignment. • Methods for verifying balance.
		Identify the risks associated with safety and equipment damage when using the techniques identified.
		Identify alternative approaches to the dismantling or assembly of equipment if the ones identified fail to achieve the required outcomes.

K11	Methods of checking components are fit for purpose, and how to identify defects and wear characteristics.	Identify how you would use a wear gauge to verify that a component is within tolerance.
		Identify how you would use a micrometre to verify that a component is within tolerance.
		Identify how you would use a calliper to verify that a component is within tolerance.
		How visual checks could be used to examine for signs of damage, leakage, missing parts, wear, or deterioration.
		How alignment checks could be carried out.
		How to use movement checks such as clearance and fit.
		How to complete checks for overheating of components.
		How to balance rotating equipment.
K12	The basic principles of how the equipment functions, operation sequence, the working purpose of individual units/ components and how they interact.	Identify why it is important to understand how a piece of plant or equipment would normally operate prior to undertaking maintenance activities.
		Identify the potential issues that may occur if there is not an understanding of how the components that make up a system are supposed to operate and interact when carrying out maintenance activities.
		Can identify the importance of knowing the operating parameters and ensuring on completion of planned activities.
K13	The identification, application, fitting, and removal of different types of bearings (such as roller, ring, thrust).	See K10 above.
		See K11 above.
		The statement is self-explanatory (expand within the portfolio questions).
K14	Methods and techniques of fitting keys and splined components.	See K10 above.
		See K11 above.
		The statement is self-explanatory (expand within the portfolio questions).
K15	Identification, application, fitting, and removal of different types of gears.	See K10 above.
		See K11 above.
		The statement is self-explanatory (expand within the portfolio questions).
K16	How to correctly tension belts and chains.	Understands the need to isolate the plant or equipment and to ensure that it can't

		be started whilst the activity is taking place.
		Knows where to find the information that indicates the minimum and maximum tensions that should be set.
		Understands how to check the tension using methods such as the belt deflection method or the use of an instrument.
K17	The identification and application of different types of locking devices.	Identify how grub screws might be utilised as retention device (the types of circumstance where this is used, and the advantages and disadvantages of this technique).
		Identify how keeper plates might be utilised as retention device (the types of circumstance where this is used, and the advantages and disadvantages of this technique).
		Identify how castled nuts and locking pins might be utilised as retention device (the types of circumstance where this is used, and the advantages and disadvantages of this technique).
		Identify how tab washers might be utilised as retention device (the types of circumstance where this is used, and the advantages and disadvantages of this technique).
K18	Methods of checking that removed components are fit for purpose, and the need to replace 'life' items (such as seals and gaskets).	See K10 above.
		See K11 above.
		Understands why items that have limited life need to be periodically replaced and the implications of in-service failure.
		Understands the relevance of "change-out" maintenance within the preventative maintenance cycle and how certain failure modes dictate the frequency of change-outs.
K19	The uses of measuring equipment (such as micrometres, verniers, run-out devices and other measuring devices).	See K11 above.
		Identify the accuracy of the different types of measuring equipment and outline the types of tasks for which they are best suited.
		Identify how measurement charts may be used.
		Identify how conversion tables may be used.

K20	How to make adjustments to components/ assemblies to ensure they function correctly (such as setting working clearance, setting travel, setting backlash in gears, preloading bearings).	See section on access to OEM drawings and manuals.
K21	The importance of making 'off-load' checks before running the equipment under power.	Identify why it is important that load tests are completed following maintenance.
		For typical equipment used in their area of work, outline how a load test would be conducted.
		Describe the things that would be typically measured as part of a load test.
		Describe the risks in carrying out a load test, and how these risks might be minimised.
K22	How to check tools and equipment are free from damage or defects, are in a safe and usable condition, and are configured correctly for the intended purpose.	For the tools that you typically use, identify the checks that should be made to ensure that they are safe to use.
		Outline the action if you were to identify that a tool was not fit for the job that you are undertaking.
		Outline what you would do if there was a tool that was defective or damaged.
K23	The importance of maintenance documentation and/ or reports following the maintenance activity, and how to generate them.	Can identify for typical maintenance activities undertaken the type of information that would normally be recorded.
		Can describe how the information is recorded on the systems in use at their operation.
		Outline how this information may be used, and why it is important that the details of maintenance activities are recorded.
		Describe the action and the information that would be recorded if the equipment was found to be defective and outside the acceptable tolerances for operation within your organisation.
K24	The equipment operating and control procedures to be applied during the maintenance activity.	See K1 of PROMT25 (isolation procedures).
		See K4 of PROMT25 (issue and sign off permits to work).
		See K5 of PROMT25 (organisational method statements).
		See K6 of PROMT25 (methodology of identifying mechanical services).
		See K20 of PROMT25 (PPE).

		Can identify any restrictions that are placed on the mechanical technician when operating plant and equipment for maintenance activities within your own organisation.
		Can outline how the area where maintenance activities are taking place is normally controlled to prevent inadvertent access.
		Can define the arrangement used in their organisation for administering energy sources for the purpose of testing as part of planned maintenance activities.
K25	How to use lifting and handling equipment in the maintenance activity.	Can outline how you would identify the type and capacity of lifting equipment required for maintenance activities.
		Can identify how you would consider planning the lift, which might include for example identifying lifting points, determining the centre of gravity.
		Can explain how their organisation rates and dates equipment that may be required for lifting operations.
		Can outline how the equipment should be set up to allow it to be operated from a safe distance.
		Can define any organisational policies that relate to the planning, carrying out of simple and complex lifts, and understands the difference between the two types of lift.
		Understands the requirement to conduct a pre-use inspection of the lifting equipment and the legislative requirements placed under the " <i>Lifting Operations and Lifting Equipment Regulations 1998</i> ".
		Understands the principles of manual handling and lifting techniques.
K26	The problems associated with the maintenance activity, and how they can be overcome.	Understands the potential issues with exposing components in the underground environments and the actions that their organisation requires them to take to minimise the risks.
		Understands the potential issues with the topping up of fluids, and the actions that can be taken to reduce the risk of contamination.
		Is able to outline how maintenance activities are planned to ensure that components that may be required are available to complete the planned activities.

		Understands the organisational procedure for procuring additional components to rectify issues identified during maintenance activities.
		Understands the process to be followed when like for like replacement components are not available.
K27	The organisational procedure(s) to be adopted for the safe disposal of waste of all types of materials.	Can define the organisational procedures for effectively managing the disposal of contaminated items.
		Can outline why consideration of waste and other materials is a key requirement of the organisational policies covering environmental impact and sustainable mining.
K28	The extent of your own authority and to whom you should report if you have a problem that you cannot resolve.	See K15 of PROMT19 (extent of your authority).

PROMT22 (MT22) – Restoring Mechanical Components to a Useful Condition by Repair

There is a question of the validity of this module in its entirety, it is likely that some mine operations don't have the types of facilities either on the surface or underground that would allow all the activities identified to take place. It may be useful to come up with a smaller version of the standard.

PROMT22 (MT22) – Restoring Mechanical Components to a Useful Condition by Repair		
Knowledge Statement		Elements
K1	The health and safety requirements of the area in which the repairing activity is to take place, and the responsibility these requirements place on you.	See K1 of PROMT16 (definition of hazard/ risk etc).
		See K2 of PROMT16 (workplace monitoring and hazard identification).
		See K3 of PROMT16 (basic requirements for completing a health and safety risk assessment).
		See K1 of PROMT25 (isolation procedures).
		See K2 of PROMT25 (definitions).
		See K3/ K4 of PROMT25 (permit to work).
		See K8 of PROMT25 (high pressure injuries).
		See K1 of SEM305 (dissipation of stored energy).
K2	The isolation procedures or permit-to-work procedure that applies.	See K1 of PROMT25 (isolation procedures).
		See K2 of PROMT25 (definitions).
		See K3/ K4 of PROMT25 (permit to work).
		See K1 of SEM305 (dissipation of stored energy).
K3	The specific health and safety precautions needed to be applied during the repairing procedure, and their effects on others.	See K1 of PROMT25 (isolation procedures).
		See K2 of PROMT25 (definitions).
		See K3/ K4 of PROMT25 (permit to work).
		See K8 of PROMT25 (high pressure injuries).
		The use of suitable barrier systems to prevent unauthorised access (exclusion zones).
		The use of notices and signs to warn of potential hazards (for example noise, dust, debris etc.).
K4	The importance of wearing protective clothing and other appropriate safety equipment during maintenance activities.	See K4 of SEM305 (the importance of wearing protective clothing and other appropriate safety equipment during the fault-finding process).

K5	The hazards associated with the repair/ restoration operations being carried out (such as sawing (hand, band), drilling, reaming, grinding (hand or machine), filing, scrapping or lapping, threading (internal or external), turning, milling and thermal processes), and how to minimise these and reduce any risks.	Outline the various hazards that may be associated with the repair and restoration, the answer should include: • Use of saws (including the hand saw/ band saw, or other saws in operation at your mine). • Use of drills (hand drills and pedestal drills). • Use of reamers. • The use of grinders (this should include both personal risks, and the risk associated with hot work activities). • Use of turning equipment (lathes). • The use of milling equipment's. • Cutting of threads (hand or machine). The candidate should consider the processes that are in place at their organisation to minimise and control the risks that have been identified. The candidate can identify the safety features that are included and should be checked as part of fixed tools and portable equipment. The candidate can identify the risks with carrying out hot work, and the restrictions and controls that are in place within their organisation to reduce these risks.
K6	Where to obtain, and how to interpret drawings, specifications, manufacturers' manuals, maintenance schedules and other relevant documents.	See K1 of PROMT09 (information sources used for drawings and specifications). See K2 of PROMT09 (how drawings and information are obtained).
K7	The methods, techniques, and company procedures to be followed for repairing mechanical equipment.	Can identify where it may be appropriate for repairs to be carried out at the mine site. Can identify the organisational arrangements for ensuring that any repairs completed on site are to a suitable standard. Can define the process for signing off any repairs completed on site, prior to the equipment/ component being returned to use.
K8	The types of repairs that can be made to components in order to prolong their useful life (such as bushing worn holes, fitting thread inserts, building up surfaces by	See K7 above. The candidate can identify typical repairs that would be permitted on site in order to extend the life of plant and equipment used in the mining operation.

	thermal process or metal spraying, making stepped keys, cutting new keyways, making stepped/ oversize dowels or studs).	The candidate can identify how drawings or records are updated to reflect changes in tolerance/ design to the manufactures specification and why these are important to allow future maintenance checks to be verified against those changes.
K9	The factors to be taken into account when deciding if a repair is practical and possible (such as is a replacement component available, cost of replacing, safety of repair, age and condition of equipment).	See K7 above.
		See K8 above.
		Self-explanatory, expand within the portfolio of questions.
K10	The need to liaise with other departments in order to have specialised operations carried out on the components (such as thermal processes, metal spraying).	See K7 above.
		See K8 above.
		Not sure if this statement really adds anything, it will be covered within the procedures.
K11	How to use filing, scraping, and lapping to achieve the required surface finish (such as various types of files/ scrapers, checking that file/ scraper handles are in good condition, the range of lapping mediums).	See K7 above.
		Identify the types of method that can be used to ensure that the surface finish is completed to the tolerances.
K12	How to cut internal and external threads (such as using hand dies and taps, machine cutting).	Can outline the process for cutting internal threads and checking that they are to an appropriate tolerance.
		Can outline the process for cutting external threads and outline how these are to an appropriate tolerance.
		This is probably better captured within the performance section.
K13	How to produce a sliding or mating fit, and the techniques to be adopted.	Outline what is meant by: • Clearance fit. • Transition fit. • Interference fit.
		Identify what is meant by a mating fit.
		Identify how the tolerances are listed for the various types of fit.
K14	How to select saw blades for different materials and different operations.	Identify how tooth pitch is an important factor when selecting a saw blade.
		Identify the various types of teeth that a saw blade would have, and how these and tooth count influence the typical materials used within your areas of responsibility.

		Outline the differences between bi-metal and carbon steel blades when selecting a saw blade.
K15	The types and application of portable power tools that can be used for the fitting operations.	Can identify the various types of portable power tools that are available for use in their organisation.
		Can identify any restrictions that exist on the use of portable tools within your organisation (consider battery and mains powered tools).
K16	How to check that portable power tools and extension cables are in a safe usable condition.	Identify the checks that should be made on a mains portable power tool prior to connecting it to the supply.
		Identify any tripping device that needs to be inserted in the cable feeding the portable appliance as part of the organisational policy.
		Identify any checks that need to be completed on any extension cables prior to plugging them in to the mains supply.
K17	How to use hand power tools and specialist equipment correctly (such as electrical, pneumatic, lifting equipment).	This is probably better captured within the performance section.
K18	The operating requirements of the machine tools and accessories being used (such as guards, work holding devices, taper turning attachments, steadies, dividing heads, specific statutory regulations, and British Standards such as the "Provision and Use of Work Equipment Regulations 1998").	Understands the risk from exposed rotating parts of machinery. Is able to identify where machinery guarding is inadequate and not to use, isolate and report.
		Understands the regulatory requirements when applying the "Provision and Use of Work Equipment Regulations 1998" (PUWER 98) for machinery to be adequately guarded.
		Understands what specific British Standards are applicable. For example, BS EN 12413: 1999 Safety requirements for bonded abrasive products.
		Understands the primary objective of PUWER 98 is to ensure that work equipment, including abrasive wheels, does not give rise to risks to health and safety, regardless of the work equipment's age, condition, or origin.
K19	The various shapes and types of tooling that can be used (such as solid high-speed tooling, brazed tip	<i>Self-explanatory, expand within the portfolio of questions.</i>

	tooling, interchangeable tipped tooling).	
K20	How to handle and store tools and equipment safely and correctly.	Identify the organisational procedure for the handling and storing of tools.
		Identify any organisational requirements relating to checks to be performed on tools prior to their use.
		Understands the limited "shelf-life" of some tools and equipment and to identify when an item is out-of-date and to remove from service.
K21	Factors which affect the selection of cutting feeds and speeds, and the depth of cut that can be taken (such as workpiece rigidity, machine condition, type of tooling being used, material type, finish and tolerance required).	Develop questions that pull out the key requirements of the knowledge statements.
K22	The application of cutting fluids with regard to a range of different materials and processes.	The types of compounds and fluids that may be used when machining components.
		Identify the limitations of the cutting fluids and compounds and the different types that may be used with different materials.
		Identify the potential health issues that using the type of fluids can have, and how these are best controlled.
K23	The techniques and implications of clamping of a workpiece in a chuck/ work holding device (such as safely secured for the process, causing distortion in the finished components).	When carrying out machining activities, identify the various methods that may be used to avoid damage from the way the material is gripped or to protect from distortion due to over tightening.
		Identify how materials being machined should be positioned or centred prior to machining taking place.
K24	How to recognise machining faults, and how to identify when tools need re-sharpening/ dressing.	Identify how you might recognise that there is an issue with machines or tools based on the finish to the surfaces.
		Identify how you might recognise that there is an issue with machines or tools based on surface marking.
K25	The operating requirements of the thermal processes and accessories being used (such as any statutory regulations and quality standards to be observed, guards, work holding	Identify the organisational procedures to control hot works on site at the mine.
		Identify organisational procedures for allowing hot work a designated places underground.

	devices, fume extraction, gas storage).	Identify how the fumes (where present) from hot work activities are controlled.
		Identify how the gasses associated with hot works are stored in the workplace.
		Identify the maximum quantities of gasses that are allowed to be stored in the workplace.
		Identify any PPE that you may be expected to wear during hot work activities (variations for different activities).
		Identify the standards that have to be followed when carrying out welding activities on components that may be under tension or compression when installed.
		Understands the regulatory requirements when applying the "Provision and Use of Work Equipment Regulations 1998" (PUWER 98) for machinery to be adequately guarded.
		Understands the regulatory requirements when applying the "Provision and Use of Work Equipment Regulations 1998" (PUWER 98). As equipment must be maintained so that its performance does not deteriorate to the extent that people are put at risk. Includes parts of equipment such as guards and ventilation equipment.
		Understands the regulatory requirements when applying "The Control of Substances Hazardous to Health Regulations 2002 (as amended)" to ensure that thorough examination and testing of local exhaust ventilation (LEV) is carried out.
K26	The methods that can be used to position the workpiece in relation to the cutting tools.	Not required
K27	The effects of backlash in the machine slides and how this can be overcome.	Not required
K28	The company recording procedures to be used following repair, and how to apply them.	See K7 above.
		See K8 above.
		See K9 above.
K29	The problems associated with repair, and how to resolve them.	Identify the types of problem that may be encountered when making a repair.
		Identify the type of issues that may occur when installing components that have been repaired to equipment that has been in operation for significant periods of time.

		Identify how the problems can be resolved to ensure that the component/ equipment is safe and reliable to operate.
K30	The extent of your own authority and to whom you should report if you have problems that you cannot resolve.	See K15 of PROMT19 (extent of your authority).

PROMT23 (MT23) – Producing Replacement Components for Maintenance Activities

There is a question of the validity of this module in its entirety, it is likely that some mine operations don't have the types of facilities either on the surface or underground that would allow all of the activities identified to take place. It may be useful to come up with a smaller version of the standard.

PROMT23 (MT23) – Producing Replacement Components for Maintenance Activities		
Knowledge Statement		Elements
K1	The safe working practices and procedures to be followed whilst carrying out the machining activities.	See K1 of PROMT16 (definition of hazard/ risk etc).
		See K2 of PROMT16 (workplace monitoring and hazard identification).
		See K3 of PROMT16 (basic requirements for completing a health and safety risk assessment).
		See K1 of PROMT25 (isolation procedures).
		See K2 of PROMT25 (definitions).
		See K3/ K4 of PROMT25 (permit to work).
		See K8 of PROMT25 (high pressure injuries).
		See K1 of SEM305 (dissipation of stored energy).
K2	The safety mechanisms on the machine, and the procedure for checking that they are operating correctly.	For typical machines used for manufacturing new components (lathes, shapers, milling machines, drills etc.) identify the safety features that should be present on each machine.
		For each of the machines, and each of the safety devices identified, outline the organisational procedure for carrying out operational checks.
		Identify the actions that need to be taken in the event that any of the safety devices fail their operational tests.
		Understands the risks if the safety features are not in place and working as designed.
K3	How to operate all the machine controls, in both hand and power modes, and how to stop the machine in case of an emergency.	For the machines identified in K2 above, outline the following: • How the machine is turned on. • How the machine is turned off. • How the machine is stopped in the event of an emergency. • The typical controls that are present on the machine and the function of each of those controls.

K4	The importance of wearing appropriate protective clothing and equipment, and of keeping the work area clean and tidy.	See K4 of SEMEM305 (the importance of wearing protective clothing and other appropriate safety equipment during the fault-finding process).
		See K2 above.
		See K3 above.
		Identify any specific restriction on clothing when using machines for the manufacture of components.
		Identify why it is important that workspaces within a workshop/ manufacturing environment are maintained in a clean and tidy state as practicable.
K5	How to obtain and interpret drawings, specifications, manufacturers' manuals, and other documents needed in the manufacturing process.	See K1 of PROMT09 (information sources used for drawings and specifications).
		See K2 of PROMT09 (how drawings and information are obtained).
K6	How to take measurements and produce working sketches of parts to be made, where no drawings are available.	Can define the procedure that might be used for taking measurements and sketches that could be utilised to reproduce a component.
		Can identify the tolerances that would be required when making a replacement component to ensure that the equipment can operate safely and reliably.
		This is probably better captured within the performance section.
K7	How to use filing, scraping, and lapping to achieve the required surface finish (such as the various types of files/ scrapers, checking that file/ scraper handles are in good condition, types of lapping mediums).	See K11 of PROMT22 (how to use filing, scraping and lapping etc.).
		Identify the types of method that can be used to ensure that the surface finish is completed to the tolerances.
K8	How to cut external threads using hand dies, and the method of fixing and adjusting the dies to give the correct thread fit.	See K12 of PROMT22 (how to cut external threads etc.).
K9	How to determine the drill size for tapped holes and the importance of using the taps in the correct sequence.	Can outline where the information can be found and give examples of the size of hole required for a particular thread size.
		Can define the method for cutting internal threads, and why there is a requirement to use various taps in the right sequence to achieve the required standard.
K10	How to produce a sliding or mating fit.	See K13 of PROMT22 (how to produce a sliding or mating fit).

K11	How to select saw blades for different materials and different operations.	See K14 of PROMT22 (how to select saw blades etc.).
K12	The use of vice jaw plates to protect the workpiece from damage.	When carrying out maintenance and repair activities, identify the various methods that may be used to avoid damage from the way the material is gripped or to protect the component from distortion etc.
K13	How to correctly use hand power tools and specialist equipment (such as electrical, pneumatic, lifting equipment).	See K14 of PROMT22 (how to select saw blades etc.).
K14	How to check that portable power tools, extension cables and air hoses are free from damage and are in a safe, usable condition.	See K116 of PROMT22 (how to that power tools etc.).
K15	The operating requirements of the machine tools and accessories being used (such as guards, work holding devices, taper turning attachments, steadies, dividing heads, specific statutory regulations).	See K18 of PROMT22 (operating requirements of the machine tools etc.).
K16	The various shapes and types of tooling that can be used (such as solid high-speed tooling, brazed tip tooling, interchangeable tipped tooling).	See K19 of PROMT22 (various shapes of tooling etc.).
K17	How to handle and store tools and equipment safely and correctly.	See K20 of PROMT22 (handle and store tools etc.).
K18	Factors which affect the selection of cutting feeds and speeds, and the depth of cut that can be taken (such as workpiece rigidity, machine condition, type of tooling being used, material type, finish and tolerance required).	See K21 of PROMT22 (factors which affect the selection of cutting feeds and speeds etc.).
K19	The application of cutting fluids with regard to a range of different materials and processes.	See K22 of PROMT22 (application of cutting fluids etc.).
K20	The techniques and implications of clamping a workpiece in a chuck/ work holding device (such as safely secured for the process, not causing distortion in the finished components).	See K23 of PROMT22 (techniques and implications of clamping a workpiece etc.).

K21	How to recognise machining faults and identify when tools need re-sharpening/ dressing.	See K24 of PROMT22 (recognise machining faults etc.).
K22	Types and applications of grinding wheels, methods of mounting, and why some wheels require balancing.	Identify the different types of grinding tools that may be in place in your workplace: • Pedestal mounted. • Workbench mounted. • Portable. Identify the differences between the types of grinder and their application and limitations.
K23	The relevant regulations, standards and guidance that apply when using abrasive wheels.	Outline how the Provision and Use of Work Equipment Regulations relate to abrasive wheels. Outline how the ACOP on the use of abrasive wheels is applied in your organisation. Describe the controls and procedures that are in place to control the use of abrasive wheels in the workplace, including any limitations that are placed on their use within the mine environment. Understands what specific British Standards are applicable. For example, BS EN 12413: 1999 Safety requirements for bonded abrasive products. Understands the primary objective of PUWER 98 is to ensure that work equipment, including abrasive wheels, does not give rise to risks to health and safety, regardless of the work equipment's age, condition, or origin.
K24	The methods that can be used to position the workpiece in relation to the cutting tools.	See K26 of PROMT22 (methods that can be used to position, etc.).
K25	The effects of backlash in the machine slides, and how this can be overcome.	See K27 of PROMT22 (effects of backlash in the machine slides, etc.).
K26	The problems that can occur with the machining and fitting activities, and how these can be overcome.	Not required
K27	The extent of your own authority and to whom you should report if you have problems that you cannot resolve.	See K15 of PROMT19 (extent of your authority).

SEM309 (MT24) – Carrying Out Planned Maintenance on Mechanical Equipment

SEM309 (MT24) – Carrying Out Planned Maintenance on Mechanical Equipment		
Knowledge Statement		Elements
K1	The health and safety requirements of the area in which the planned maintenance activity is to take place, and the responsibility these requirements place on you.	See K1 of PROMT16 (definition of hazard/ risk etc).
		See K2 of PROMT16 (workplace monitoring and hazard identification).
		See K3 of PROMT16 (basic requirements for completing a health and safety risk assessment).
		See K1 of PROMT25 (isolation procedures).
		See K2 of PROMT25 (definitions).
		See K3/ K4 of PROMT25 (permit to work).
		See K8 of PROMT25 (high pressure injuries).
		See K1 of SEM305 (dissipation of stored energy).
K2	The isolation procedures or permit-to-work procedure that applies to the equipment being maintained.	See K1 of PROMT25 (isolation procedures).
		See K2 of PROMT25 (definitions).
		See K3/ K4 of PROMT25 (permit to work).
		See K1 of SEM305 (dissipation of stored energy).
K3	The specific health and safety precautions to be applied during the planned maintenance activity, and their effects on others.	See K23 of PROMPR23 (the specific health and safety precautions).
K4	The importance of wearing protective clothing and other appropriate safety equipment (PPE) during the maintenance activities.	See K4 of SEM305 (the importance of wearing protective clothing and other appropriate safety equipment during the fault-finding process).
		General PPE is covered within the MG1 and MG2 (Safe in the Underground Environment). This is more specific to the maintenance activities.
K5	Hazards associated with carrying out planned maintenance activities on mechanical equipment (such as handling oils/ greases, stored pressure/ force, misuse of tools), and how to minimise these and reduce any risks.	See K5 of SEM305 (hazards associated with fault diagnosis on mechanical equipment).
K6	Where to obtain, and how to interpret, drawings, specifications, manufacturers' manuals, maintenance schedules and other relevant documents.	See K1 of PROMT09 (information sources used for drawings and specifications).
		See K2 of PROMT09 (how drawings and information are obtained).

K7	The various planned maintenance schedules that are generally used (such as condition-based maintenance, scheduled maintenance, and total preventative maintenance (TPM)).	Identify the different types of planned maintenance that might be scheduled, the answer should consider: • Routine. • Condition based. • Time/ use based. • Breakdown. Identify for the above how this maintenance is scheduled, and the outputs of the maintenance recorded. Define how the output of maintenance informs the future maintenance requirements.
K8	How to calculate overall equipment effectiveness (OEE) and use this information to show the benefits of planned maintenance on relevant items where it has been applied.	Can identify why it is important to know how a piece of equipment is performing. Can define the implication on the operation when the performance of plant and equipment is lower than that was budgeted. Can define how their organisation records and calculates the overall equipment effectiveness (or other measures). Understands the cumulative effect of reduced overall equipment effectiveness of various items on the mining process.
K9	The procedure for obtaining consumables to be used during the planned maintenance activity.	Can define how consumables are obtained in their organisation ahead of planned maintenance activities at their mine. Can outline how minimum stock levels of consumables are maintained at their mine. Understands the importance of booking out consumable items for use in maintenance, to ensure that: • The costs of ownership are fully understood. • The usage rate of consumable items can be monitored, and reorder quantities adjusted. • Maintaining adequate quantities of the required consumables.
K10	How to make appropriate sensory checks (such as sight, sound, smell and touch).	See K12 of SEM305 (how to evaluate sensory information). Identify the precautions that would be taken when using the sensors to determine the condition of plant and equipment. Identify how the information from sensory checks might be used to provide

		information about the health and operation of plant and equipment.
K11	The appropriate testing procedures to be adopted during the maintenance activity.	See K7 of SEM305 (procedures to establish a fault).
		See K8 of SEM305 (evaluating information).
		See K10 of SEM305 (how to use various test equipment).
		See K7 of PROMT25 (tests to be carried out on mechanical circuits).
K12	How to make adjustments to components/ assemblies to ensure they function to specification.	Can identify where the normal operating procedures for a piece of plant and equipment can be found.
		Can identify how a mechanical technician would determine if a piece of plant or equipment was outside the prescribed operating limits.
		Can describe the process that a mechanical technician would typically use to adjust the operating parameters.
		Can define how a mechanical technician would test the plant and equipment following any adjustments to ensure that it will continue to function safely.
		Can outline the actions that a mechanical technician would take, if it had not been possible to bring the plant and equipment back to the defined operational limits.
K13	The functionality of various mechanical components and their interrelationship with other components and assemblies.	This is very broad. Can see how it could be related to a shaft with bearings on and a gear mounted on it also, so it's the relationship not only of those items with each other but also what is turning the shaft and whatever the gear is driving. So, I guess it is about having an understanding of the fact that all components have to be designed taking into account other components they interact with. Identify how to carry out a rotational speed test.
K14	How to compile planned maintenance records/ logs/ reports in accordance with company policy and procedures.	Can identify the information that would normally be completed on the completion of maintenance activities by a mechanical technician in their organisation.
		Can identify why this type of information may be important to the safe efficient operation of the mine.

		Can define information that would be required should the plant or equipment fail its tests, and the actions that would be expected of a mechanical technician in their organisation.
K15	The equipment operating and control procedures, and how to apply them in order to carry out planned maintenance.	See K1 of PROMT25 (isolation procedures).
		See K4 of PROMT25 (issue and sign off permits to work).
		See K5 of PROMT25 (organisational method statements).
		See K6 of PROMT25 (methodology of identifying mechanical services).
		See K20 of PROMT25 (PPE).
		See K24 of PROMPR23 (equipment operating and control procedure).
K16	The problems that can occur whilst carrying out the planned maintenance activities, and how they can be avoided.	See K26 of PROMPR23 (the problems that can occur).
K17	The organisational procedure(s) to be adopted for the safe disposal of waste of all types of materials.	See K27 of PROMPR23 (organisational procedures to be adopted).
K18	The extent of your own authority and to whom you should report if you have problems that you cannot resolve.	See K15 of PROMT19 (extent of your authority).

PROMT25 (MT25) – Working Safely on Mechanical Equipment in Mines

PROMT25 (MT25) – Working Safely on Mechanical Equipment in Mines		
Knowledge Statement		Elements
K1	Isolation procedure(s) to be followed to comply with organisational procedures.	Can define the isolation procedure that is used within their organisation, and the principle of lock out/ tag out / try out (LOTOTO) .
		Can define the isolation procedures for dealing with other sources of energy for example hydraulic and pneumatic pressure, rope, and conveyor tension.
		Understands the principles of energy dissipation as part of an isolation procedure for electrical and other energy sources.
		Understands the principle of isolating for self.
		Understands the principle of isolating for self and others.
		Understands how the method statements may be used to control isolation sequences, and why observing defined sequence of isolation may be important to the safety of themselves and others within the mine.
		Understands how the method statements may be used not only to control isolations, but to provide information on other aspects of the procedures to be followed to ensure that a job is completed safely.
		Understands how the method statements may be used to identify the effect on safety critical equipment (pumps, monitoring systems etc).
		Understands the process for reinstatement of electrical (and other energy sources) at the end of task.
		Identify where any notices should be posted indicating that work is taking place on plant/ equipment, and it must remain isolated.
		Any other information that needs to be posted or present.
		The organisational requirement for applying multiple locks where more than one person/ discipline is working on the plant and equipment.
K2	The meaning of the terms: • Approved lock. • Personal lock. • Safety lock. • Operational lock. • Lock box. • Authorised.	Can define the terms outlined within K2 of these requirements.

	- Scheduled work. - Hierarchy of isolation. - Isolated. - Electrical equipment. - Dead. - Danger notice. - Earthed. - Safe system of work. - Permit to work.	
K3	- The legal status of a permit to work. - When a "permit to work is required. - The circumstances when a permit may not be required. - Why a permit to work system is used when isolating electricity.	Can define the terms outlined within K3 of these requirements.
K4	Organisational procedures for the issue and signing off "permits to work".	Understands how permits to work are produced at the site. Understands the procedure for signing on to a permit to work. Understands the process for reinstatement of electrical (and other energy sources) at the end of task. Define how isolations may be removed for the purpose of testing. Understands the process to get sanctions for testing within their organisation. Understands the procedure for clearing a permit to work when the task has been completed. Understands what to do if the work has not been completed and the permit needs to remain in place to allow the system to remain safe. Understands what to do if the work planned cannot be completed, and the permit needs to be suspended, cancelled, or remain in place. The arrangement used within the organisation when more than one person/ or more than one discipline carrying out simultaneous tasks on any plant/ equipment. Understands the requirements for electrical permits in line with guidance from Electricity at Work Safe Working Practices HSG85.
K5	Organisational method statements (Standard Operating Procedures).	See K1 above. Understands the content requirement for methods statements. Understands how the method statements are issued. Understands how the method statements are returned, and any information that

		needs to be appended or returned with the document on the completion of the task.
K6	Methods used to identify mechanical services.	Understands the organisational procedure that is used to identify various services that are installed underground at your mine.
		Understands how an organisation identifies the valves/ joints/ isolation points on the various services used underground.
		Understands the organisational process for tracing pipes, hoses and other services used underground.
K7	Tests to be carried out on mechanical circuits.	Can define what is meant by a pressure test.
		Can define what is meant by a flow test.
		Explain how to carry out a rotational speed test.
		Explain how to carry out an inclined speed test.
		Define how torque and force can be measured.
		Can define the limits on pressure/ flow or other parameters which you are allowed to work before it is classified as live working within their organisation.
		Define where live work may be used within an organisation.
		Understands why in certain circumstances it may be beneficial to consider live working.
		Understands the organisational procedures/ controls that are required to allow live working to take place, including the use of an appropriate permit to work.
		Understands any personal authorisations that are required in order to be allowed to work live.
		The uses of notices to signify the risk of live working taking place to others that may enter the work area.
		Can identify how test results are verified against the OEM or organisational standards.
		Can identify how test results are recorded and why recording the information is important.
K8	Causes of high-pressure injection injuries in mines.	See K1 of PROMT25 (isolation procedures).
		Can define the main source(s) of potential high pressure injection injuries in their mine.
		Can define other potential circumstances that may lead to a failure and the

		unplanned high-pressure discharge from that pressure system.
		Understands how the operation of plant can cause pressure to be built up in components, (for example moving a cylinder with fluid inside).
		Understands how hydraulic accumulators work, and the potential risks that come from the operations of these when interfaced to a hydraulic circuit.
K9	Potential injuries associated with high pressure equipment/ services/ systems.	The statement is self-explanatory (expand within the portfolio questions).
K10	Purpose and use of equipment and facilities provided for dealing with high pressure injuries.	Identify the procedure for making yourself and others safe when approaching a potential victim of a high-pressure injury.
		Identify the equipment that may be required when dealing with a high-pressure injury.
		Identify the type of injuries that may require treatment if an individual has received a high-pressure injury.
		Identify how the equipment may be used to treat the potential injuries associated with a high-pressure injection.
K11	Treatment of casualty who has received a high-pressure injection injury.	See K10 above.
		The statement is self-explanatory (expand within the portfolio questions).
K12	Organisational and legislative reporting requirements should a high-pressure injection injury/ incident occur.	Outline the requirements under the Reporting of Injuries, Disease and Dangerous Occurrence Regulations 2013.
		Outline the requirements under the Pressure Vessels Regulations.
		Outline the internal requirements of your organisation to a high-pressure injection injury or high-pressure incident.
K13	Procedures to be followed to communicate details of the high-pressure emergency.	Outline how details are shared within the organisation.
		Outline how details might be shared with the wider organisation (if applicable).
		Outline how details may be shared across the wider sector.
K14	The main principles of health and safety and environmental legislation	Understands how the Mines Regulations 2014 require an organisation to think about

	and regulations relevant to using mechanical equipment in mines.	the use of equipment underground in the mine.
		Understands the requirements of the Provision and Use of Work Equipment Regulation 1989 and any requirements that these regulations impose on using mechanical equipment and systems in a mine.
		Understands the principles of the Lifting Operations and Lifting equipment Regulations 1995 and how they apply to operations at the mine.
		Understands the principles of the Dangerous Substances and Explosive Atmosphere Regulations and how these may apply.
		Understands how the Health and Safety at Work Act 1974 applies to the installation, use and maintenance of equipment installed in mines.
		Understands how the Control of Substances Hazardous to Health Regulations 2002 apply to operations in underground mines
K15	Industrial Standards relevant to using mechanical equipment in mines.	Understands where and how to access BS EN standards.
		Understands and can apply any appropriate BS EN standard applicable.
K16	Approved codes of practice and guidance for working safely with mechanical equipment and systems in mines.	Understands the regulatory requirements placed under the "Provision and Use of Work Equipment Regulations 1998" Regulation 5 that requires equipment is maintained.
		Understands the regulatory requirements placed under the "Provision and Use of Work Equipment Regulations 1998" Regulation 22 that requires equipment is constructed or adapted in a way that takes account of the risks associated with carrying out maintenance work, such as routine and planned preventive maintenance.
K17	The different types and categories of hazards and hazardous situations in mines in general, and in your area of responsibility in particular.	Can identify the major hazards as defined by the Mines Regulations 2014 that might be present generally within a mine.
		Can identify other specific dangerous occurrences as listed within the Reporting of Injuries, Disease and Dangerous Occurrence Regulations that might be relevant to a mine.

		Can identify other hazards which might be found within a mine.
		Can identify the hazards that might normally be present in your normal area of responsibility.
		Can define some of the key controls that are put in place to manage those hazards.
K18	Organisational and legislative requirements for inspections, examinations, and testing.	Outline what the Mines Regulations 2014 say in relation to inspection, examination, and testing of equipment specifically regulation 15 installed in a mine.
		Understands what the organisations requirements are for the systematic inspection, examination and testing of equipment installed below ground.
		Define what your organisation means by the terms: • Commissioning. • Inspection. • Examination. • Test.
K19	Methods of communication in hazardous or emergency situations.	Outline how you would communicate in the event of an emergency, and the systems that are in place within the operation to support that communication.
		Define some of the detail that you may be asked when initially reporting an emergency.
K20	Types, use and maintenance requirements of personal protective equipment provided to protect hazards arising from mechanical equipment.	Identify some of the personal protective equipment that you may be issued with to help protect you from creating a situation where you receive high pressure or other injuries associated with mechanical equipment.
		Outline the daily tests that should be completed on this type of equipment to ensure that it is operational before entering the mine.
		Outline the procedures on site to exchange faulty protective equipment prior to entering the mine.
		Define the tests that should be completed on any personal protective equipment, immediately prior to it being used.
		Outline the actions that should be taken if the personal protective equipment fails the test outlined above.

K21	Legislation, approved codes of practice and guidelines for safe use of equipment.	See K14 above.
		See K15 above.
		See K16 above.
K22	The use of equipment/ tools provided in accordance with manufacturers' instructions.	Outline what the Provision and Use of Work Equipment Regulations 1998 say in relation to the provision of instructions.
		Outline what the Health and Safety at Work Act says in relation to the requirement of an employee to follow instructions.
		Outline what The Supply of Machinery (Safety) Regulations 2008 require for the use of machinery.
K23	The causes and sources of stored energy, safe methods for dissipation.	Can define how fixed plant is isolated, and how the fact that it is isolated and is brought to the attention of others.
		Can define the organisations procedures to prevent electricity (or other sources of energy) from being inadvertently re-applied to any plant or equipment that has been isolated.
		Can define the type of equipment in use at their mine where there is potential for stored energy to be present.
		Can describe how they would identify the presence of stored energy with the mechanical systems prior to carrying out planned work activities.
		Can outline in each circumstance the process for dissipating the stored energy and verifying that it has been dissipated for the equipment identified above.
K24	Organisational procedures for the safe isolation of plant and machinery.	See K1 above.
K25	Know your own responsibilities and limitations.	Define the various levels of authorisation that exist within your organisation.
		Outline what is required to move between these various levels of authorisation within your organisation.
		Define your own limitations and responsibilities, in relation to the organisations scheme.
K26	Methods of effective communication.	Identify the means of communication that may be utilised within your mine and function to effectively communicate deployment, work activity, actions completed and any outstanding issues.

		The various communication mediums used within your department and why?
K27	The allocation of tasks and duties.	See K8 of PROMPT8 (alterations to meet changing circumstances/ management of change).
		Identify how your organisation or department determines the tasks to be completed within the shift.
		Outline how these tasks are allocated to you.
		Define how the tasks are co-ordinated between departments to make sure that safety and production are maintained.
		How changes to the plan, or task are communicated with you during the shift.
		How you and others prioritise the tasks that you are given and those that are reactionary by nature and occur during the course of a normal shift.
K28	The benefits of teamwork, and how to achieve it.	<i>The statement is self-explanatory (expand within the portfolio questions).</i>

Other Knowledge Considerations

The existing National Occupational Standards are focused on safety and organisational process, and for a solid foundation for developing a competent technician. The standards could be light on technical content, and it is suggested that these could be supplemented by adding some of the following.

It may be some theory elements are delivered as part of a college-based course, and therefore the requirements of the knowledge could be covered through that mechanism. (An organisation like the national fluid power centre (NFPC) would be ideal.)

Electrohydraulic Systems

Elements of this proposed addition is taken from the L3 BTEC Unit 15 (Ref K/600/0204) [Electro Pneumatic and Hydraulic Systems].

Area	Criteria for Measuring Knowledge
Know about the legislation, regulations and safety precautions that apply when working with fluid power system.	Health and Safety at Work Act 1974.
	Employment Act 2002.
	European Conformity (CE marking/ UK marking) Regulations.
	Management of Health and Safety at Work Regulations 1999.
	Provision and Use of Work Equipment Regulations 1998.
	Control of Substances Hazardous to Health (COSHH) Regulations 2002.
	Lifting Operations and Lifting Equipment Regulations 1998.
	Manual Handling Operations Regulations 1992.
	Personal Protective Equipment at Work Regulations 1997.
	Electricity at Work Regulations 1989.
	Control of Noise at Work Regulations 2005.
	Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995.
	Workplace (Health, Safety and Welfare) Regulations 1992.
	Health and Safety (First Aid) Regulations 1981.
	Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2004.
	Simple Pressure Vessels (Safety) Regulations 1991.
Safety precautions when working with electro pneumatic and hydraulic systems.	Risk assessment of fluid power systems.
	Assembling and testing electro, pneumatic and hydraulic systems, and devices e.g.,

	isolation of services (such as electrical, air, oil).
	Escape of fluids at high pressure which may cause contact injury.
	Hydraulic oil contact with the skin.
	Sudden movement of linear actuators causing entrapment injuries.
	Personal protective equipment (PPE) e.g., safety glasses, gloves, overalls, footwear.
Know the construction and operation of fluid power devices and how they are represented as symbols in circuit diagram.	Fluid Power Devices - Fluid conditioning e.g., supply tank, filter, pump, cooler, compressor, dryer, receiver, accumulator. - Fluid supply e.g., pipework, fittings, seals, drainage points. - Electrical supply systems e.g., mains, low voltage regulated power supply units, AC, DC. - Fluid control valves e.g., directional (manual and solenoid), pilot, 4 port, 5 port, pressure reducing, non-return, flow rate. - Actuators e.g., linear, rotary; motors (electric, air, hydraulic). - Position sensors e.g., reed switch, pressure switch, inductive, microswitch. - System control e.g., programmable logic controller (PLC), electro mechanic.
	Symbols - Relevant and current standards e.g., BS3939, BS2917, ISO 1219, European Fluid Power Committee (CETOP). - Symbols for common components e.g., fluid conditioning, fluid supply, electrical supply, control valves, actuators, motors, sensors, control.
	Circuit Diagrams - Diagrams e.g., pneumatic, hydraulic, block diagrams, system layout, displacement step diagrams. - Reference material e.g., component and equipment data sheets, ISO 1219-2, software (such as FluidSIM or Automation Studio).
Be able to apply fluid power principles in the design of circuits.	Fluid power principles - Properties and behaviour of air and hydraulic fluids. - Gas laws e.g., Boyle's, Charles', Gay-Lussac's, general gas, dew point. - Fluid flow e.g., Bernoulli's principle, volumetric rate, receiver volume, actuator flow requirements. - Fluid pressure e.g., units of measurement, Pascal's law, inlet and outlet pressure, pressure drop, actuator

	efficiency, clamping force; formulae ($P_1 V_1 T_2 = P_2 V_2 T_1$, displaced volume = piston area x stroke, volumetric flow rate = displaced volume/time, absolute pressure = gauge + atmospheric pressure, force = pressure x area, actuator force = pressure x area x efficiency). Circuits • Pneumatic e.g., multi-cylinder sequential operation, single-cylinder reciprocation with dwell, position and clamp an object using a two-cylinder arrangement, rotary actuator with reversing action. • Hydraulic e.g., multi-cylinder sequential operation, single-cylinder reciprocation with dwell and regeneration, hydraulic motor with reversing action.
Be able to carry out maintenance, inspection, testing and fault-finding on fluid power systems.	Maintenance • Routines e.g., frequency of maintenance, manuals, and reference documentation, keeping of accurate records using paper- or software-based systems; components (electro, pneumatic, hydraulic). • Systems e.g., electro-pneumatic, electro-hydraulic inspection: functional e.g., at component level, as a system, performance against specification. • Keeping of accurate records; report e.g., component drawing, system circuit diagram, digital images, inspection checklist, record of visual observations made against checklist, conclusions, recommendations. Testing • Performance e.g., against specification, reliability; keeping of accurate records. • Report e.g., system circuit diagram, system specification, test schedule, list of test equipment, record test results, record visual observations, compare test results with system specification, recommendations for future actions. Fault Finding • Identify faults in fluid power systems e.g., manual diagnosis, visual examination, unit substitution, input to output, injection and sampling, half-split technique, six-point technique, self-diagnostic techniques using programmable electronic equipment, effect of malfunctions. • Fault-finding aids e.g., functional charts, diagrams, flow charts, troubleshooting

	charts, component data sheets, operation and maintenance manuals, specialised equipment. • Record faults e.g., paper based, software based, analyse data. • Report e.g., system circuit diagram, record test results, record visual observations, compare test results with system specification, record faults and cross reference to circuit diagram, identify type of fault, strategy for rectification of fault.
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The Installation of Mechanical Equipment

The recommendations are based on the national occupational standard for the installing mechanical equipment (SEMIC305).

Area	Criteria for Measuring Knowledge
The specific safety practices and procedures that you need to observe when installing mechanical equipment (including any specific legislation, regulations, or codes of practice for the activities, equipment, or materials).	This is covered within the standards previously reviewed within this document.
The procedures to be carried out before starting work on the installation (such as obtaining permits to work, obtaining, and complying with risk assessments and other health and safety requirements).	This is covered within the standards previously reviewed within this document.
The health and safety requirements of the work area where you are carrying out the installation activities, and the responsibility these requirements place on you.	The implications of major hazards within the defined work area (covered within other sections of this documents).
	Identification of hazards that may be present or become present through the work activity (partially covered within other sections of this documents).
	Ensuing that installation activities are carried out in line with the safe systems of work and operating procedures at the site.
	Providing suitable levels of instruction and supervision for those that are assisting but are not qualified and competent mechanical technicians.
The hazards associated with installing mechanical equipment, and with the tools and equipment used, and how they can be minimised.	Understands the hazards of lifting using lifting appliances (covered within other areas of this document).
	Understands the manual handling hazards associated with the installation of mechanical equipment (covered within other areas of this document).
	The safe use and checking of tools and equipment that are to be used to carry out the installation (covered within other areas of this document).
	The principles of risk assessment and point of work risk assessment (covered within other areas of this document).
The personal protective equipment (PPE) that you need to use for the installation activities, and where it can be obtained	This is covered within other elements of the document.
How to carry out currency/ issue checks of the specifications you are working with	Where to obtain documents relating to the installation (covered within other areas of this document).
	How to identify other sources of information (covered within other areas of this document).

	Verifying that the work area/ installation area meets the specification requirements.
	Verifying the foundations are prepared to the required standard.
The interpretation of drawings, standards, quality control procedures and specifications used for the installation (including BS and ISO schematics, symbols, and terminology).	That suitable installation drawings with appropriate information, produced on an appropriate scale are available.
	That all the drawings required to component level are available.
	That the components are true to the drawings provided.
The equipment to be installed, its operating procedures and function.	That there are manuals that clearly define: • The installation parameters, along with the permitted tolerances (relating to areas such as alignment/ level etc.). • The operating specification for the plant and equipment to be installed. • The operating parameters for the plant and equipment to be installed.
	The manuals clearly define how the plant and equipment should operate, with details of functional tests that should be completed as part of the installation and commissioning procedures.
Methods of marking out the site for positioning of the equipment, and the tools and equipment used for this.	Identify how your organisation identifies the areas for equipment installation.
	Outline how your organisation would lay out the site, this may include elements such as: • Centre line. • Offsets. • Position of key equipment.
	The marking out of anchor points or lifting points.
Methods of drilling holes for rag and expanding bolts (including the use of grouting and adhesives).	Identify how fixed plant installed within their operation is secured to the floor or roof.
	Identify the standard within their organisation that determines how these types of fixings are installed.
	Identify how these types of fixing are tested to ensure that they are working within their design parameters.
The various mechanical fasteners that will be used, and their method of installation (including threaded fasteners, special securing devices, masonry fixing devices).	Outline the various specifications for mechanical fasteners such as nuts and bolts.
	Identify how you would identify the appropriate tensile strength of a mechanical fastener from a drawing.
	Identify how you would identify the mechanical fasteners tensile strength (nuts and bolts).
	The types of arrangements that may be used on vibrating or mobile plant to prevent the fastener from becoming loose.
	Identify the means that would be used to determine the maximum and minimum

The torque loading requirements of the fasteners, and what to do if these loadings are exceeded or not achieved.	torques that mechanical fastener can be subjected to.
	Identify the means by which this torque can be verified.
	Identify the actions that should be taken if the torques setting required cannot be achieved.
	What arrangements would be done if this could not be achieved on a blind hole.
The procedures for ensuring that you have the correct tools, equipment, and fasteners for the installation activities.	See above.
The types of tools and instruments used to position, secure, and align the equipment (such as spanners, wrenches, crow bars, torque wrenches, engineer's levels, alignment telescopes, laser devices).	See the list and ask that the candidate determine how a piece of equipment might be aligned (reference the items mentioned within the national occupational standard).
The techniques used to position, align, level, and adjust the equipment.	Outline how equipment would be positioned during an installation.
	Define why it is important that during an installation the components arrive in the correct sequence.
	Identify how you might identify the sequence of installation from the drawings and information provided.
Methods of lifting, handling, and supporting the equipment during the installation activities.	Identify the various means that may be used for lifting equipment in to place during an installation.
	The checks for lifting equipment (these are covered within other modules).
	Identify various means to support equipment above ground level when carrying out the installation.
	The means to verify that the equipment is stable prior to working in the area.
	The need to establish suitable zones to avoid mobile plant striking equipment that has been supported, but not secured as part of the installation process.
Methods of connecting to mechanical power transmission devices (such as belt and chain drives, couplings, clutches, brakes).	Identify the various ways that power can be transferred from part of the system to the other (in the actual requirements reference the list of items provided).
Methods of connecting equipment to service supplies (such as electrical, fluid power, compressed air oil and fuel supplies).	As above.
Why electrical bonding is critical, and why it must be both mechanically and electrically secure.	Identify why some items of plant must have good quality electrical bonding, tying the installation to earth must be installed.
	Identify the implications of having bonding that has not been installed correctly, and therefore has a high resistance path to earth.
The procedure for the safe disposal of waste materials.	See other parts of the standards.

How to conduct any necessary checks to ensure the equipment integrity, functionality, accuracy, and quality of the installation (including the fitting of guards to all moving parts, covers on electrical connections).	How equipment is commissioned to organisational and OEM standards.
	How functionality of the equipment is confirmed as part of the commissioning arrangements.
	How the standard of installation is verified as part of the commissioning, compliance with regulations, and organisational standards.
How to recognise installation defects (such as leaks, poor seals, misalignment, ineffective fasteners, foreign object damage, contamination).	The arrangement to deal with any parts of the installation that fall below regulatory, OEM or organisational standards.
	The process that might be used by the mechanical technician to identify potential defects with the installed system.
	How defects are reported and tracked to completion within the organisation.
	The arrangement for handing over an installation from an engineering function to the operational departments.
The importance of ensuring that the completed installation is free from dirt, swarf, and foreign object damage, and of ensuring that any exposed components or pipe ends are correctly covered/protected.	See other sections.
The calibration/ care and control procedures for tools and equipment.	See other sections.
The problems that can occur with the installation operations, and how these can be overcome.	Identify why having a timed installation program is important.
	Identify how the project is sequenced to ensure that the right equipment is available at the right times (project delays).
	Identify the actions that your organisation takes to ensure that components fit together as part of the installation.
	Identify the arrangement that the organisation has in place to minimise loss and damage during transport and installation.
	Identify the testing that would normally be completed ahead of the installation to ensure that equipment supplied by different manufactures will fit and work together.
	Identify how the organisation ensures that there are appropriate numbers of qualified and competent people available to complete the installation to the required standard in the defined time.
The fault-finding techniques to be used when the equipment fails to operate correctly.	See other sections.
The recording documentation to be completed for the activities undertaken.	See other sections

The extent of your own responsibility, and whom you should report to if you have problems that you cannot resolve.	See other sections.
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Performance Elements

The performance elements have been captured directly into the portfolio layout, the tables in this section provide information on the performance statements listed within the National Occupational Standards.

MPQVG01 (MT17) – Operate Safely in the Mine Environment

These performance elements can be satisfied by completing the common induction module (working safely and efficiently in the underground environment).

MPQVG02 (MT18) – Confirm to Efficient Work Practices

These performance elements can be satisfied by completing the common induction module (working safely and efficiently in the underground environment).

PROMT8 (MT8) – Confirm Work Activities and Resources for Work

PROMT8 (MT8) – Confirm Work Activities and Resources for Work		
Performance Statement		Elements
P1	Identify the work activities and assess the resources required from the information available and plan the programme of work to be carried out.	Included within the portfolio
P2	Obtain clarification and advice where the resources required are not available.	Included within the portfolio
P3	Evaluate the work activities against project requirements and the requirements of any significant external factors.	Included within the portfolio
P4	Identify work activities which influence each other and make the best use of the resources available.	Included within the portfolio
P5	Identify changed circumstances that will require alterations to the work programme and justify them to the decision makers.	Included within the portfolio

PROMT9 (MT9) – Using Engineering Drawings and Documents in Maintenance Activities

PROMT9 (MT9) – Using Engineering Drawings and Documents in Maintenance Activities		
Performance Statement		Elements
P1	Use the approved source to obtain the required drawings and specifications.	Included within the portfolio
P2	Correctly interpret the drawings and specifications.	Included within the portfolio
P3	Identify, extract, and interpret the required information.	Included within the portfolio
P4	Use the information obtained to ensure that work output meets the specification.	Included within the portfolio
P5	Deal promptly and effectively with any problems within your control and report those which cannot be solved.	Included within the portfolio
P6	Report any inaccuracies or discrepancies in drawings and specifications.	Included within the portfolio

PROMT16 (MT16) – Identify and Address Mine Engineering and Safety Hazards and Risks

PROMT16 (MT16) – Identify and Address Mine Engineering Health and Safety Hazards and Risks		
Performance Statement		Elements
P1	Identify hazards in your area of work.	Included within the portfolio
P2	Identify hazards and risks arising from your work.	Included within the portfolio
P3	Identify people who are at risk from hazards.	Included within the portfolio
P4	Assess the level of risk arising from the hazard.	Included within the portfolio
P5	Seek advice from managers or specialists in risk assessment when appropriate.	Included within the portfolio
P6	Report hazards immediately to the responsible person(s).	Included within the portfolio
P7	Deal with hazards which constitute a low risk and are within your limits of responsibility in accordance with organisational and operational procedures.	Included within the portfolio
P8	Give suggestions to control or reduce risks to health and safety to the responsible persons.	Included within the portfolio
P9	Check tools and materials are suitable for the task.	Included within the portfolio
P10	Check and ensure plant/ machinery/ equipment is made safe for the task.	Included within the portfolio
P11	Carry out task according to specified procedure/s.	Included within the portfolio
P12	Report problems and conditions outside the limits of your responsibility to the appropriate person/s.	Included within the portfolio
P13	On completion ensure plant/ machinery/ equipment is in an appropriate safe condition.	Included within the portfolio
P14	Report completion of task according to organisational procedures.	Included within the portfolio

PROMT19 (MT19) – Handing Over and Confirming Completion of Maintenance Activities

PROMT19 (MT19) – Handing Over and Confirming Completion of Maintenance Activities		
Performance Statement		Elements
P1	Work safely at all times, complying with health and safety and other relevant regulations and guidelines.	Included within the portfolio
P2	Confirm that everyone involved accepts the product or asset is in a satisfactory condition for handover to take place.	Included within the portfolio
P3	Clearly identify any unusual features of the condition of the product or asset.	Included within the portfolio
P4	Make the handover and obtain agreement between everyone involved on the precise moment of transfer of responsibility.	Included within the portfolio
P5	Deal promptly and effectively with problems within your control and report those that you cannot solve.	Included within the portfolio
P6	Make sure that clear, accurate and complete records of the handover are made.	Included within the portfolio

SEM305 (MT20) – Carrying Out Fault Diagnosis on Mechanical Equipment

SEM305 (MT15) – Carrying Out Fault Diagnosis on Mechanical Equipment		
Performance Statement		Elements
P1	Work safely at all times, complying with health and safety and other relevant regulations and guidelines.	Included within the portfolio
P2	Review and use all relevant information on the symptoms and problems associated with the products or assets.	Included within the portfolio
P3	Investigate and establish the most likely causes of the faults.	Included within the portfolio
P4	Select, use, and apply diagnostic techniques, tools, and aids to locate faults.	Included within the portfolio
P5	Complete the fault diagnosis within the agreed time and inform the appropriate people when this cannot be achieved.	Included within the portfolio
P6	Determine the implications of the fault for other work and for safety considerations.	Included within the portfolio
P7	Use the evidence gained to draw valid conclusions about the nature and probable cause of the fault.	Included within the portfolio
P8	Record details on the extent and location of the faults in an appropriate format.	Included within the portfolio

PROMPR23 (MT21) – Maintaining Mechanical Equipment

PROMPR23 (MT21) – Maintaining Mechanical Equipment		
Performance Statement		Elements
P1	Work safely at all times, complying with health and safety and other relevant regulations and guidelines.	Included within the portfolio
P2	Follow the relevant maintenance schedules to carry out the required work.	Included within the portfolio
P3	Carry out the maintenance activities within the limits of your personal authority.	Included within the portfolio
P4	Carry out the maintenance activities in the specified sequence and in an agreed time scale.	Included within the portfolio
P5	Report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule.	Included within the portfolio
P6	Complete relevant maintenance records accurately and pass them on to the appropriate person.	Included within the portfolio
P7	Dispose of waste materials in accordance with safe working practices and approved procedures.	Included within the portfolio

PROMT22 (MT22) – Restoring Mechanical Components to a Useful Condition by Repair

PROMT22 (MT22) – Restoring Mechanical Components to a Useful Condition by Repair		
Performance Statement		Elements
P1	Work safely at all times, complying with health and safety and other relevant regulations and guidelines.	Included within the portfolio
P2	Follow the relevant specifications for the component to be repaired.	Included within the portfolio
P3	Prepare the component for repair.	Included within the portfolio
P4	Carry out the repairs within agreed timescale using approved materials and components and methods and procedures.	Included within the portfolio
P5	Ensure that the repaired component meets the specified operating conditions.	Included within the portfolio
P6	Produce accurate and complete records of all modification work carried out.	Included within the portfolio

PROMT23 (MT23) – Producing Replacement Components for Maintenance Activities

PROMT23 (MT23) – Producing Replacement Components for Maintenance Activities		
Performance Statement		Elements
P1	Work safely at all times, complying with health and safety and other relevant regulations and guidelines.	Included within the portfolio
P2	Follow the appropriate procedures for use of tools and equipment to carry out the required tests.	Included within the portfolio
P3	Produce the required components using appropriate manufacturing methods and techniques.	Included within the portfolio
P4	Check that the finished component meets the requirements and make any necessary adjustments.	Included within the portfolio
P5	Deal promptly and effectively with problems within your control and report those that cannot be solved.	Included within the portfolio

SEM309 (MT24) – Carrying Out Preventative Planned Maintenance on Mechanical Equipment

SEM309 (MT24) – Carrying Out Preventative Planned Maintenance on Mechanical Equipment		
Performance Statement		Elements
P1	Work safely at all times, complying with health and safety and other relevant regulations and guidelines.	Included within the portfolio
P2	Follow the relevant maintenance schedules to carry out the required work.	Included within the portfolio
P3	Carry out the maintenance activities within the limits of your personal authority.	Included within the portfolio
P4	Carry out the maintenance activities in the specified sequence and in an agreed time scale.	Included within the portfolio
P5	Report any instances where the maintenance activities cannot be fully met or where they are identified.	Included within the portfolio
P6	Complete relevant maintenance records accurately and pass them on to the appropriate person.	Included within the portfolio
P7	Dispose of waste materials in accordance with safe working practices and approved procedures.	Included within the portfolio

PROMT25 (MT25) – Working Safely on Mechanical Equipment in Mines

PROMT25 (MT25) – Working Safely on Mechanical Equipment in Mines		
Performance Statement		Elements
P1	Identify equipment to be worked on and their correct isolation point(s).	Included within the portfolio
P2	Communicate effectively with other members of the team should unscheduled work arise that may require use of a permit to work.	Included within the portfolio
P3	Identify whether the isolation will have any effect on the safe operation of the mine and take appropriate action.	Included within the portfolio
P4	Where practicable ensure that there are arrangements in place to prevent the inadvertent build-up of pressure.	Included within the portfolio
P5	Ensure that isolation points are locked in a safe position in accordance with company/ organisation procedures.	Included within the portfolio
P6	Post warning notices according to organisational procedure.	Included within the portfolio
P7	Check relevant safety equipment prior to acceptance/ use in accordance with manufacturers' instructions/ company procedures.	Included within the portfolio
P8	Carry out work in accordance with company/ organisational requirements.	Included within the portfolio
P9	Complete records/ reports according to legislative requirements and organisational procedures. Correct use of permit to work system.	Included within the portfolio
P10	Recognise who is authorised to issue a permit to work.	Included within the portfolio
P11	Plan the job to minimise danger to those involved.	Included within the portfolio
P12	Communicate effectively with those involved in the activity.	Included within the portfolio
P13	Obtain a permit to work in accordance with organisational requirements.	Included within the portfolio
P14	Ensure relevant equipment is isolated.	Included within the portfolio

P15	Ensure equipment is locked off/ isolated.	Included within the portfolio
P16	Confirm all works completed and staff/ tools accounted for according to organisational procedures.	Included within the portfolio
P17	Cancel permit according to organisational procedures.	Included within the portfolio
P18	Restore mechanical services in accordance with company/ organisational requirements.	Included within the portfolio
P19	Complete permit as required by organisational procedures.	Included within the portfolio
P20	Identify/ mark/ trace cables in accordance with company/ organisational procedures.	Included within the portfolio
P21	Follow organisational procedure when it is not possible to trace a cable.	Included within the portfolio
P22	Check and ensure all tools/ equipment used have organisational approval.	Included within the portfolio
P23	Carry out tests on mechanical equipment/ systems in accordance with statutory/ organisational requirements.	Included within the portfolio
P24	Use all test and ancillary equipment in accordance with manufacturers and organisational instructions.	Included within the portfolio
P25	Carry out tasks safely and in accordance with organisational procedures.	Included within the portfolio
P26	When required, carry out live work safely and in accordance with specific procedures.	Included within the portfolio
P27	Take appropriate steps to minimise danger from mechanical equipment that is found to be defective.	Included within the portfolio
P28	Complete records/ reports according to legislative requirements and organisational procedures.	Included within the portfolio