T-LEVELS | Institute for Apprenticeships & Technical Education

T Level Technical Qualification in Science

Occupational specialism assessment (OSA)

Metrology Sciences

All assignments

Provider guide

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Contents

Introduction

This occupational specialism is assessed by a synoptic assessment consisting of a package of 3 assignments. The assignments require the student to independently apply an appropriate selection of knowledge, understanding, skills and techniques developed throughout the full course of study in response to briefs or tasks. This will allow the student to demonstrate that they have met a level of threshold competence in the performance outcomes of the occupational specialism.

The synoptic assessment for this occupational specialism is graded pass, merit or distinction, and the final grade will contribute 50% of the overall technical qualification grade. Therefore, it is important that students have the opportunity to produce work of the highest standard they can. The assignments within this synoptic assessment are designed to allow the student to do this in a way that is as occupationally realistic as possible.

What is threshold competence?

Threshold competence is defined as a level of competence that:

- signifies that a student is well-placed to develop full occupational competence, with further support and development, once in employment
- is as close to full occupational competence as can be reasonably expected of a student studying the technical qualification in a provider-based setting with a substantial industry placement
- signifies that a student has achieved the level for a pass in relation to the relevant occupational specialism component

This level is reflected in the grading descriptors of the occupational specialism and successful completion of the assignments will ensure that students are well-placed to develop full occupational competence once in employment. Grading descriptors can be found in the technical qualification specification document.

What is synoptic assessment?

Synoptic assessment is a form of assessment in which students are required to demonstrate that they can identify and use in an integrated way an appropriate selection of skills, techniques, concepts, theories, and knowledge from across the technical area, relevant to the tasks.

Synoptic assessment is integral to high-quality technical qualifications to allow students to demonstrate a holistic understanding of the sector, making effective connections between different aspects of the subject content.

The assignments and tasks in this assessment are designed to be synoptic in a way that is as occupationally realistic as possible.

How will students be assessed?

Students will be assessed against the following set of performance outcomes (POs) that describe what the student should be able to do:

Metrology Sciences POs	
PO1	Plan appropriate scientific measurement for any measure and to comply with regulatory requirements
PO2	Perform scientific measurement tasks using the most appropriate measurement for a measurand to ensure accuracy
PO3	Collect, analyse and interpret data from measurand tasks
PO4	Identify and resolve issues with measurement tools and equipment

The synoptic assessment consists of 3 assignments:

1. Perform a visual inspection on a range of length measurement equipment and use a suitable piece of equipment to perform a measurement equipment check, accompanied by a written report on the findings of the visual inspection.
2. Write a measurement plan, based on a technical drawing and use this plan in order to inspect critical features of a batch of machine-made parts. Analyse the data and present it, reporting on the performance and suitability of the machine used to produce the parts.
3. Correct a technical drawing sent from a customer. Calculate a cost production per part, based on the corrected technical drawing and design a plan in order to inspect and measure the key features based on the technical drawing.

Assignments are broken down into tasks where necessary. The assignments, tasks, and associated guidance for students and tutors show how the assignments are expected to be delivered.

Evidence produced by students for the assignments will be sent to NCFE for marking. Assessment judgements, including overall judgement of the performance required at each of the grade boundaries, will be made by NCFE and results released to the provider at the appropriate time.

Assignment coverage

See the table at the end of this provider guide which shows how the PO content is covered by the assignments and tasks.

Controls

There is a requirement for work completed under supervised conditions to be collected and securely stored; that controls are in place to ensure that providers do not release materials to their students until the appropriate time, and that when they do release materials that they are retrieved as appropriate; that tasks are designed in ways that minimise any advantage students might gain by having prior knowledge of what they entail.

Where the occupational specialism assessments allow for research requiring the use of the internet, students must reference the sources in their work.

Marks

The marks available for each assignment are detailed below.

Assignment		Raw marks	% Weighting
1	Perform an equipment inspection, an equipment check, and a report on the findings	67	28.6%
2	Write a measurement plan, undertake the measurement of sample parts and analyse the results	104	44.5%
3	Correct a technical drawing, produce an inspection cost per part and write a plan to measure the produced part	63	26.9%
	Total	**234**	**100%**

Assessment timings

Assignment 1 consists of 3 tasks.

Task 1: This involves students completing a visual inspection of 6 different pieces of equipment and recording the results. Part of this is assessed through direct observation, as this cannot be assessed based on a written piece of evidence, the entire process cannot be recorded on paper, and there is not a correct outcome that can be associated with a written response. A risk assessment is also included within this task, but this is submitted as a written piece and marked by NCFE. The first task will be allocated 1 hour 30 minutes to complete.

Task 2: Students will then select one piece of equipment, compare it against a suitable standard and then use the selected piece of equipment to measure a provided wooden template. Again, this is assessed through observation and the submission of their results because there cannot be a correct answer for the size of the template, due to the equipment chosen and differences in the production of the templates. The second task will be allocated 1 hour 30 minutes to complete.

Task 3: The evidence submitted for tasks 1 and 2 will be provided in order for students to complete their report on the outcome of task 1 and 2. This is a written task and the evidence will be marked externally by NCFE. The third task will be allocated 1 hour 30 minutes to complete.

Timings for this assessment must be adhered to by the provider.

Total time for assignment 1 = 4 hours 30 minutes.

Assignment 2 also consists of 3 tasks.

Task 1: This requires the student to write a plan in order to measure the key aspects of a part shown in a diagram. This is a written piece and is marked externally by NCFE. The first task will be allocated 2 hours 30 minutes to complete.

Task 2: In the second task students conduct a measurement of a sample of parts, using the plan designed in task 1, while recording all results and repairing all possible errors in the equipment and machine-made parts. The repair process and measurement process are assessed through observation, while results are also submitted to be assessed. The time allocated for task 2 is 2 hours 30 minutes.

Task 3: The final task of the assignment is an analysis of the data collected in task 2. This is presented in graphical and table format with a written report discussing the findings and the recommendations for improvement. This task is assessed externally by NCFE and has been allocated 2 hours to complete.

Timings for this assessment must be adhered to by the provider.

Total time for assignment 2 = 7 hours.

Assignment 3 is a 100% written assessment and does not require assessor observation or time in a workshop or metrology lab setting. Assignment 3 consists of 3 tasks.

Task 1: Requires students to correct a technical drawing.

Task 2: Requires students to calculate a cost production per part based on a corrected technical drawing.

Task 3: Requires students to develop a written plan to measure each feature following production.

The overall time for assignment 3 is 4 hours 30 minutes. Task 1 is allocated 30 minutes, task 2 is allocated 1 hour 30 minutes, and task 3 is allocated 2 hours 30 minutes. As this assignment is completed under consistent conditions, the student is allowed to manage their own time themselves, and the timings are only provided as guidance.

Total time for assignment 3 = 4 hours 30 minutes.

All evidence created, generated, and recorded for these assignments is subject to data protection rules, and information should be anonymised to protect the rights of individuals where relevant.

Recommended equipment list

- balance 200g x 0.01g
- F1 weight set 200g – 1mg
- M1 weight set 200g – 1mg
- liquid in glass thermometer
- digital thermometer
- heat plate
- digital micrometer
- digital vernier calliper
- analog micrometer
- analog vernier calliper
- 1m rigid rule (metal)
- 1m rigid rule (wooden)
- 20m flexible tape (class I)
- 20m flexible tape (class II)
- Infra-red distance measurer
- slip gauges to calibrate micrometers
- single graduation volumetric flasks
- glass pipettes
- micro pipettes
- measuring cylinders
- pycnometer

- fluid flowmeter
- electronic multimeter
- analogue multimeter
- pH meter
- force gauge
- torque meter
- digital timer

Assignment specific guidance

Assignment 1: perform an equipment inspection, an equipment check, and a report on the findings

Required material

The required material will be sent to providers ahead of the assessment window. Providers must issue the preliminary material to their students upon commencement of task 1.

The required material for assignment 1 is a range of handheld measuring equipment (minimum of 6 per student, suitable for 3 different areas outlined in the assessment) from the equipment list (such as tape measures, callipers and rules) and a wooden template measuring 60cm x 60cm x 60xcm, one per student. The students should select 6 different pieces of equipment, however, they can select variations of the same equipment if they are suitable for the business areas/departments (design, manufacturing, and installation), for example, if a 1m rigid rule (wood) is suitable for 2 departments, the student can inspect 2 rules if there are 2 different rules available.

As the assessment only assesses the skills for the measurement activity, and not the results taken during the task, the accuracy and tolerances of the equipment will not impact on the outcome of the assessment, therefore, students can use their own equipment if it is suitable. A piece of equipment can be inspected by more than one student, so equipment can be rotated to allow multiple students to complete the task. A suitable standard must be available for each piece of equipment, to allow completion of task 2.

Assessment conditions

This assignment is to be completed under supervised conditions over a period of 4 hours 30 minutes, split into 3 different tasks to take 1 hour and 30 minutes each, during a week-long assessment window. The 1 week assessment window will be specified by NCFE.

Tasks 1 and 2 should be conducted within the appropriate workshop or metrology laboratory, whichever environment the student has been using in the provider environment. The room or workshop should be organised so that each student has their own workspace, placed at a distance where it would not be feasible for other students to see the detail in which other students complete the assessment in. If a student leaves their workstation for any reason for the completion of the assessment, all their notes and papers must be covered with a blank sheet of paper.

The maximum time allowed for tasks 1 and 2 is 3 hours. At the end of the 3 hours, all assessment evidence should be collected by the provider and be provided when task 3 is to be completed.

Task 3 is a written assignment and should be completed under exam conditions following JCQ regulations. Students should be provided with their written results from tasks 1 and 2 to complete their report. The report is then handed in with all results from tasks 1 and 2 for external marking. Task 3 is allocated a time of 1 hour 30 minutes.

Providers must ensure that their entire cohort of students complete the 4 hours 30 minutes for this assignment on the same day. Timings for this assessment must be adhered to by the provider.

All practical activity should be visually recorded on a suitable device to be provided as evidence of completion of the practical tasks. These recordings should be submitted along with a completed observation checklist for tasks 1 and 2, the completed risk assessment template and all written evidence for task 3.

Audio-visual evidence

It is a requirement of the delivery of this assessment that all student performances are audio-visually recorded for the purpose of moderation.

It is the provider's responsibility to check that the appropriate audio-visual (AV) equipment is set up and fully operational at each station. The AV recording must clearly identify the students, capture all relevant actions and words from the student, be clear and of sufficient quality to be adequately reviewed by the moderator.

Provider staff should be equipped to be able to operate the equipment sufficiently to capture all evidence.

To ensure authenticity of the performance, the student's face must be clearly visible at the start of the recording.

Providers may schedule supervised rest breaks during the assessment. Any rest breaks must be supervised, and students must not have access to any resources during this time. In addition, assessment materials must be kept secure and must not be removed from the supervised environment.

Students may not have access to the internet and may not bring anything into the supervised environment.

Students are required to sign declarations of authenticity to confirm that all the work they complete during the supervised assessment is their own. Students must be made aware of the importance of this declaration and the impact it could have on their overall grade, if malpractice was to be identified. Providers must also ensure that the students work is authenticated by the tutor before it is submitted to NCFE for marking. The declaration forms are available on the NCFE website.

The assignment is a formal external assessment and must be conducted with reference to the instructions on the front of the assignment booklet, as well as the regulations for the conduct of external assessment and qualification specific instructions for delivery (QSID) documents, which should be accessed from www.qualhub.co.uk to ensure they are the most up to date versions. Providers are not allowed to give any support or guidance to students during the supervised time. Students must ensure that all materials can be identified as their own work.

Assignment 2: write a measurement plan, undertake the measurement of sample parts and analyse the results

Required material

The required material will be sent to providers 1 week ahead of the assessment window. Providers must issue the preliminary material to their students upon commencement of task 2.

Required materials for assignment 2, task 2: A sample of steel components in 2 batches; batch A should be finished parts with no known errors. Batch B should be unfinished parts or parts with known repairable errors, such as non-completion of the de-burring process. All measurements are measured in millimetres.

Please note sample steel components must be provided by centres.

Graph paper, calculator, stationary for drawing graphs are required for task 3.

The required material for assignment 2 is a range of equipment from the equipment list and a minimum of 25 sample parts per student.

Each student should have their own batch of at least 25 parts from batch A and 25 parts from batch B. These should be available before the start of the assessment. These should be provided in 1 sample to the student at their workstation. The student should not be informed that there are 2 different batches within their sample and should not be told that there is a group with any known errors. These sample parts should be provided by the provider.

Assessment conditions

This assignment is to be completed under supervised conditions over a period of 7 hours. Providers will be given preliminary material and details of the assignment ahead of the assessment window.

The assignment consists of 3 tasks:

1. Task 1 is a written assessment and should be completed under exam conditions following JCQ regulations. This task is allocated 2 hours 30 minutes to complete and the student's work should be collected following the completion of task 1 as this is externally marked by NCFE.
2. During task 2, the students should be in their workshop or metrology lab setting, whichever environment the student has been studying in. All equipment should be available to them and the sample parts should be provided, a suitable number from each batch. The students should also be provided their plan from task 1 to use during the measurement task, as this can be updated if any additional steps have been taken which have not been outlined in the original plan. This is an observed assessment, with the measurement and repairs being witnessed. The student's results should be recorded in preparation for task 3. The room or workshop should be organised so that each student has their own workspace, placed at a distance where it would not be feasible for other students to see the detail in which other students complete the assessment in. If a student leaves their workstation for any reason for the completion of the assessment, all their notes and papers must be covered with a blank sheet of paper. All evidence should be collected by the provider and stored until the start of task 3.

3. Task 3 is a written assignment and should be completed under exam conditions following JCQ regulations. The students should be provided with a copy of their plan and results from tasks 1 and 2, but not the original copies as editing the results and plan is not permitted at this stage. The results from task 2 are used as the basis for task 3. This task is assessed externally by NCFE and has been allocated 2 hours to complete.

Students may not have access to the internet and may not bring anything into the supervised environment.

All practical activity should be visually recorded on a suitable device to be provided as evidence of completion of the practical tasks. These recordings should be submitted along with the written plan for task 1 and 2, the completed risk assessment template, and all written evidence for task 3.

Audio-visual evidence

It is a requirement of the delivery of this assessment that all student performances are audio-visually recorded for the purpose of moderation.

It is the provider's responsibility to check that the appropriate audio-visual (AV) equipment is set up and fully operational at each station. The AV recording must clearly identify the students, capture all relevant actions and words from the student, be clear and of sufficient quality to be adequately reviewed by the moderator.

Provider staff should be equipped to be able to operate the equipment sufficiently to capture all evidence.

To ensure authenticity of the performance, the student's face must be clearly visible at the start of the recording.

Due to the length of the assessment, it is recommended that the assignment is completed over more than 1 day. If this approach is taken, tasks 1 and 2 must be completed on the same day, so students cannot discuss details of the plan with each other before completing the measurement task. All materials must be submitted at the end of task 2 and only a copy should be provided for completion of task 3, to ensure that submitted materials are not altered in any way. Timings for this assessment must be adhered to by the provider.

Students are required to sign declarations of authenticity to confirm that all the work they complete during the supervised assessment is their own. Students must be made aware of the importance of this declaration and the impact it could have on their overall grade, if malpractice was to be identified. Providers must also ensure that the students work is authenticated by the tutor before it is submitted to NCFE for marking. The declaration forms are available on the NCFE website.

The assignment is a formal external assessment and must be conducted with reference to the instructions on the front of the assignment booklet, as well as the regulations for the conduct of external assessment and qualification specific instructions for delivery (QSID) documents, which should be accessed from www.qualhub.co.uk to ensure they are the most up to date versions.

Providers are not allowed to give any support or guidance to students during the supervised time, unless the students are operating in a manner which may endanger themselves or others, if this is required, this aspect of performance will be reflected in the mark scheme.

Students must ensure that all materials can be identified as their own work.

Assignment 3: correct a technical drawing, produce an inspection cost per part and write a plan to measure the produced part

Required material

None

Assessment conditions

Assignment 3 is a 100% written assignment and should be completed under exam conditions following JCQ regulations.

This assignment is to be completed under supervised conditions over a period of 4 hours 30 minutes during a week-long assessment window. The 1 week assessment window will be specified by NCFE. The assignment has a guidance of 30 minutes for task 1, 1 hour and 30 minutes for task 2 and 2 hours and 30 minutes for task 3. As this assignment is completed under consistent conditions, the student is allowed to manage their own time themselves and the timings are only provided as guidance.

Providers must ensure that their entire cohort of students complete the 4 hours 30 minutes for this assignment on the same day.

Providers may schedule supervised rest breaks during the 4 hours and 30 minutes. Any rest breaks must be supervised, and students must not have access to any resources during this time. In addition, assessment materials must be kept secure and must not be removed from the supervised environment.

Students may not have access to the internet and may not bring anything into the supervised environment.

Students are required to sign declarations of authenticity to confirm that all the work they complete during the supervised assessment is their own. Students must be made aware of the importance of this declaration and the impact this could have on their overall grade, if malpractice was to be identified. Providers must also ensure that the students work is authenticated by the tutor before it is submitted to NCFE for marking. The declaration forms are available on the NCFE website.

The assignment is a formal external assessment and must be conducted with reference to the instructions on the front of the assignment booklet, as well as the regulations for the conduct of external assessment and qualification specific instructions for delivery (QSID) documents, which should be accessed from www.qualhub.co.uk to ensure they are the most up to date versions. Providers are not allowed to give any support or guidance to students during the supervised time. Students must ensure that all materials can be identified as their own work.

Assignment coverage

Assignment 1: perform an equipment inspection, an equipment check, and a report on the findings

Task 1

K1.1: The concept of measurement

K1.2: How metrology is defined

K1.3: The importance of metrology to society and everyday life

K1.6: How the accuracy of measurements is related to tolerance and cost

K1.15: How an unbroken chain of comparisons, directly related to the international system of units (SI), ensures confidence in results

K1.17: Techniques for gaining confidence in measurement

K1.25: The difference between validation and verification of scientific measurement equipment

K1.26: The correct terminology for measurement in metrology

K1.27: The impact of using incorrect terminology when communicating about measurement

K1.33: Why different sample preparation methods are required when preparing an item for measurement

K1.34: The most relevant sources to use to extract measurement requirements

K1.42: How to mitigate risk using control measures

K1.43: The hierarchy of written standards and their application in a metrology environment

K2.5: Use the escalation route if the calibration status is not identifiable, or if the instrument is clearly out of calibration

K4.1: How to recognise when measuring equipment is operating incorrectly

S1.51: Use the correct terminology for measurement in metrology

S1.55: Plan any specific preparation tasks needed on the item to be measured

S1.61: Complete a risk assessment appropriate to the measurement task

S4.4: Use problem solving techniques to identify issues relating to measuring equipment

Task 2

K1.1: The concept of measurement

K1.2: How metrology is defined

K1.3: The importance of metrology to society and everyday life

K1.4: The definition of measurement standards

K1.5: The use of measurement standards in calibration

K1.6: How the accuracy of measurements is related to tolerances, cost and timescales

K1.7: The concept and purpose of measurement uncertainty

K1.8: How most sources of uncertainty can be categorised

K1.9: The difference between repeatability and reproducibility of measurement results

K1.11: The concept of random and systematic effects

K1.12: How to mitigate for random and systematic effects

K1.13: The role of measurement uncertainty in conformity assessment

K1.14: The concept of confidence levels using k = 1 (≈68%), k = 2 (≈95%) and k = 3 (≈99.7%):

K1.21: The purpose of an uncertainty budget

K1.22: The components of an uncertainty budget, used to calculate measurement uncertainty

K1.29: The International System of Units (SI)

K1.30: The tools and equipment (and software programs where applicable) used within the operating principles

K1.31: The considerations when deciding on the most appropriate equipment and tools to be used

K1.32: The advantages and limitations of different commercially available equipment and instrumentation used within the operating principles

K1.41: The considerations to make when interpreting customer requirements

K1.43: The hierarchy of written standards and their application in a metrology environment

K2.1: The purpose of validation or verification techniques for measuring equipment

K2.2: The purpose of calibrating and testing metrology equipment

K2.3: How to check the current calibration status

K2.4: Why it is important to follow the correct escalation route if an instrument's calibration status is not identifiable, or if the instrument is clearly out of calibration

K2.5: The escalation route if the calibration status is not identifiable, or if the instrument is clearly out of calibration

K3.1: The stages of processing raw data

K3.2: The purpose of the following techniques to remove spurious results from metrology data

S1.50: Read a simple uncertainty budget for a measurement task and use it

S2.6: Prepare the work environment in order to perform measurement tasks

S2.7: Set up the equipment and the item to be measured

S2.8: Read and follow a calibration procedure

S2.9: Determine the current calibration status of a system to ensure the equipment is at the required level of accuracy

S2.10: Select/prepare the correct reference material/standard for the measurement task

S2.11: Perform a measurement task using a developed plan

S3.10: Contribute to the production of reports and other measurements

S3.11: Present data/results in the most appropriate format to meet customer requirements (for example, production of reports and other measurement documentation)

Task 3

K3.1: The stages of processing raw data

K3.2: The purpose of the following techniques to remove spurious results from metrology data

K4.1: How to recognise when measuring equipment is operating incorrectly

K4.2: The employees' responsibilities when an anomaly in the measurement process has been identified

K4.3: The considerations to make when measuring equipment needs repair

S3.10: Contribute to the production of reports and other measurement documentation

S4.4: Use problem solving techniques to identify issues relating to measuring equipment

S4.5: Discuss measurement results and issues with peers to determine when issues need to be escalated

Assignment 2: write a measurement plan, undertake the measurement of sample parts and analyse the results

Task 1

K1.1: The concept of measurement

K1.2: How metrology is defined

K1.4: The definition of measurement standards

K1.5: The use of measurement standards in the calibration of measuring equipment when planning scientific measurements

K1.6: How the accuracy of measurements is related

K1.7: The concept and purpose of measurement uncertainty

K1.8: The different ways sources of uncertainty may be categorised

K1.9: The difference between repeatability and reproducibility of measurement results

K1.10: The concept of type A and type B evaluations of uncertainty

K1.12: How to mitigate for type A and type B effects (for example, using best practice for the measurement system to minimise uncertainty)

K1.13: The role of measurement uncertainty in conformity assessment

K1.14: The concept of confidence levels using K=1 (≈68%), K=2 (≈95%) and K=3 (≈99.7%)

K1.15: How an unbroken chain of comparisons, directly related to SI units, ensures confidence in results

K1.16: The links within a traceability chain

K1.18: The purpose of measurement instruments

K1.19: The differences between automated and manual measuring instruments

K1.20: How to apply best practice principles in measurement

K1.21: The purpose of an uncertainty budget

K1.22: The components of an uncertainty budget, used to calculate measurement uncertainty

K1.23: Factors that may influence the number of repeated measurements in a measurement task

K1.24: Factors that may influence the sampling strategy

K1.26: The correct terminology for measurement in metrology

K1.27: The impact of using incorrect terminology when communicating about measurement

K1.28: The sources which may be used to calculate maximum permissible error (MPE) of a system

K1.30: The tools and equipment (and software programs where applicable) and how these are used within the operating principles

K1.31: The considerations when deciding on the most appropriate equipment and tools to be used

K1.32: The advantages and limitations of different commercially available equipment and instrumentation used

K1.33: Why different sample preparation methods are required when preparing an item for measurement

K1.35: The purpose of planning a task in metrology

K1.36: How environmental conditions such as temperature, vibration, humidity and lighting can affect both the measuring equipment and the item to be measured, and consequently the data collected

K1.37: General approaches to dealing with environmental conditions

K1.41: The considerations to make when interpreting customer requirements

K1.42: How to mitigate risk, using control measures

K1.43: The hierarchy of written standards and their application in a metrology environment

K1.44: The importance of following standard operating procedures (SOPs) when carrying out measurement tasks

K1.45: The importance of quality requirements within the workplace

S1.48: Make informed decisions about the needs of the measurement task

S1.49: Determine the design of the measurement plan

S1.50: Read a simple uncertainty budget for a measurement task and use it

S1.51: Use the correct terminology for measurement in metrology

S1.53: Select appropriate tools/equipment/instrumentation (with any associated software) when planning for a specific measurement task

S1.54: Provide reasoned decisions for the selection of equipment and instrumentation when planning a measurement task

S1.55: Plan any specific preparation tasks needed on the item to be measured

S1.57: Create a measurement

S1.58: Plan and record how to deal with potential environmental conditions

S1.61: Complete a risk assessment appropriate to the measurement task

S1.62: Document in the measurement plan the SOPs that should be followed during the measurement task, including those relevant to safe working practices (for example, handling of tools, equipment, instrumentation and software programs)

S1.63: Identify relevant regulatory procedures and standards required for the measurement task

S1.64: Document in the measurement plan the international organisation for standardisation (ISO) standards and the specific quality requirements needed for the measurement task

Task 2

K2.1: The purpose of validation or verification techniques for measuring equipment

K2.2: The purpose of calibrating and testing metrology equipment

K2.3: How to check the current calibration status

K2.4: Why it is important to follow the correct escalation route if an instrument's calibration status is not identifiable, or if the instrument is clearly out of calibration

K2.5: The escalation route if the calibration status is not identifiable, or if the instrument is clearly out of calibration

K4.1: How to recognise when measuring equipment is operating incorrectly

K4.2: The employees' responsibilities when an anomaly in the measurement process has been identified

K4.3: How repairs on measuring equipment are carried out

S2.6: Prepare the work environment in order to perform measurement tasks

S2.7: Set up the equipment and the item to be measured

S2.8: Read and follow a calibration procedure

S2.9: Determine the current calibration status of a system to ensure the equipment is at the required level of accuracy

S2.10: Select/prepare the correct reference material/standard for the measurement task

S2.11: Perform a measurement task using a developed plan

S4.4: Use problem solving techniques to identify issues relating to measuring equipment

S4.6: Source expert help from senior colleagues or others on metrology issues

S4.7: Follow the process for basic repairs on measurement equipment

Task 3

K3.1: The stages of processing raw data

K3.2: The purpose of the following techniques to remove spurious results from metrology data

K3.3: Why the following are used to interrogate and critically analyse measurement data

K3.4: How to review the measurement data obtained against measurement requirements

S1.65: Use feedback to develop and improve

S3.5: Use digital technology to process raw data and record measurement results in line with specifications

S3.6: Identify patterns in collected data

S3.7: Assess repeatability and reproducibility of measurements to determine any variation within the data and establish a degree of confidence

S3.8: Interrogate and critically analyse measurement data to identify any anomalous results

S3.9: Re-run investigations to assess invalid data

S3.10: Contribute to the production of reports and other measurement documentation

S3.11: Present data/results in the most appropriate format to meet customer requirements (for example, production of reports and other measurement documentation)

Assignment 3: correct a technical drawing, produce an inspection cost per part and write a plan to measure the produced part

Task 1

K1.20: How to apply best practice principles in measurement

K1.26: The correct terminology for measurement in metrology

K1.27: The impact of using incorrect terminology when communicating about measurement

K1.29: The International System of Units (SI)

K1.34: The most relevant sources to use to extract measurement requirements

K1.38: The role of scientific metrology, industrial metrology and legal metrology

K1.39: The roles of different organisations that support metrology practices

K1.40: How metrology can play a role in a range of industries

K1.41: The considerations to make when interpreting customer requirements

K1.47: Why it is important to remain up to date with developments in metrology

S1.51: Use the correct terminology for measurement in metrology

K3.4: How to review the measurement data obtained against measurement requirements

S1.52: Use different unit systems (SI and non-SI units) and be able to convert between units, using appropriate conversion factors or formulae

S1.56: Access and interpret information and documentation to extract measurement requirements to support the measurement task (for example, legislation, ISO and other standards, manuals, specification sheets)

S1.59: Interpret and review customer requirements from a customer brief and identify relevant factors

S1.60: Summarise key information relating to customer requirements

S3.10: Contribute to the production of reports and other measurement documentation

S3.11: Present data/results in the most appropriate format to meet customer requirements (for example, production of reports and other measurement documentation)

Task 2

K1.6: How the accuracy of measurements is related

K1.7: The concept and purpose of measurement uncertainty

K1.8: How most sources of uncertainty can be categorised

K1.9: The difference between repeatability and reproducibility of measurement results

K1.10: The concept of type A and type B evaluations of uncertainty

K1.11: How to mitigate for type A and type B effects (for example, using best practice for the measurement system to minimise uncertainty)

K1.13: The role of measurement uncertainty in conformity assessment

K1.14: The concept of confidence levels using K=1 (≈68%), K=2 (≈95%) and K=3 (≈99.7%)

K1.17: Techniques for gaining confidence in measurement

K1.20: How to apply best practice principles in measurement

K1.21: The purpose of an uncertainty budget

K1.22: The components of an uncertainty budget, used to calculate measurement uncertainty

K1.23: Factors that may influence the number of repeated measurements in a measurement task

K1.28: The sources which may be used to calculate maximum permissible error (MPE) of a system

K1.29: The International System of Units (SI)

K1.30: The tools and equipment (and software programs where applicable) and how these are used within the operating principles

K1.33: Why different sample preparation methods are required when preparing an item for measurement

K1.34: The most relevant sources to use to extract measurement requirements

K1.38: The role of scientific metrology, industrial metrology and legal metrology

K1.41: The considerations to make when interpreting customer requirements

K1.45: The importance of quality requirements within the workplace

K1.46: Why further professional development and undertaking continuing professional development (CPD) is important in metrology

K1.47: Why it is important to remain up to date with developments in metrology

K3.4: How to review the measurement data obtained against measurement requirements

S1.52: Use different unit systems (SI and non-SI units) and be able to convert between units, using appropriate conversion factors or formulae

S1.56: Access and interpret information and documentation to extract measurement requirements to support the measurement task (for example, legislation, ISO and other standards, manuals, specification sheets)

S1.59: Interpret and review customer requirements from a customer brief and identify relevant factors

S3.10: Contribute to the production of reports and other measurement documentation

Task 3

K1.1: The concept of measurement

K1.2: How metrology is defined

K1.4: The definition of measurement standards

K1.5: The use of measurement standards in the calibration of measuring equipment when planning scientific measurements

K1.6: How the accuracy of measurements is related

K1.7: The concept and purpose of measurement uncertainty

K1.8: How most sources of uncertainty can be categorised

K1.9: The difference between repeatability and reproducibility of measurement results

K1.10: The concept of type A and type B evaluations of uncertainty

K1.11: How to mitigate for type A and type B effects (for example, using best practice for the measurement system to minimise uncertainty)

K1.13: The role of measurement uncertainty in conformity assessment

K1.14: The concept of confidence levels using K=1 (≈68%), K=2 (≈95%) and K=3 (≈99.7%)

K1.15: How an unbroken chain of comparisons, directly related to SI units, ensures confidence in results

K1.16: The links within a traceability chain

K1.17: Techniques for gaining confidence in measurement

K1.18: The purpose of measurement instruments

K1.19: The differences between automated and manual measuring instruments

K1.20: How to apply best practice principles in measurement

K1.21: The purpose of an uncertainty budget

K1.22: The components of an uncertainty budget, used to calculate measurement uncertainty

K1.23: Factors that may influence the number of repeated measurements in a measurement task

K1.24: Factors that may influence the sampling strategy

K1.25: The difference between validation and verification of scientific measurement equipment

K1.26: The correct terminology for measurement in metrology

K1.27: The impact of using incorrect terminology when communicating about a measurement

K1.28: The sources which may be used to calculate maximum permissible error (MPE) of a system

K1.30: The tools and equipment (and software programs where applicable) used within the operating principles

K1.31: The considerations when deciding on the most appropriate equipment and tools to be used

K1.32: The advantages and limitations of different commercially available equipment and instrumentation used within the operating principles

K1.33: Why different sample preparation methods are required when preparing an item for measurement

K1.35: The purpose of planning a task in metrology

K1.36: How environmental conditions such as temperature, vibration, humidity and lighting can affect both the measuring equipment and the item to be measured, and hence the data collected

K1.37: General approaches to dealing with environmental conditions

K1.39: The roles of different organisations that support metrology practices

K1.42: How to mitigate risk, using control measures

K1.43: The hierarchy of written standards and their application in a metrology environment

K1.44: The importance of following SOPs when carrying out measurement tasks

K1.45: The importance of quality requirements within the workplace

K1.46: Why further professional development and undertaking continuing professional development (CPD) is important in metrology

K2.1: How to determine the appropriate validation or verification technique for measuring equipment

K2.2: The purpose of calibrating and testing metrology equipment

K2.3: How to check the current calibration

K2.4: Why it is important to follow the correct escalation route if an instrument's calibration status is not identifiable, or if the instrument is clearly out of calibration

K3.1: The stages of processing raw data

K3.3: Why the following are used to interrogate and critically analyse measurement data

K3.4: How to review the measurement data obtained against measurement requirements

K4.1: How to recognise when measuring equipment is operating incorrectly

K4.3: How repairs on measuring equipment are carried out

S1.48: Make informed decisions about the needs of the measurement task

S1.49: Determine the design of the measurement plan

S1.50: Read a simple uncertainty budget for a measurement task and use it

S1.51: Use the correct terminology for measurement

S1.53: Select appropriate tools/equipment/instrumentation (with any associated software) when planning for a specific measurement task

S1.54: Provide reasoned decisions for the selection of equipment and instrumentation when planning a measurement task

S1.55: Plan any specific preparation tasks needed on the item to be measured

S1.57: Create a measurement plan

S1.58: Plan and record how to deal with potential environmental conditions

S1.63: Identify relevant regulatory procedures and standards required for the measurement task

S1.64: Document in the measurement plan the ISO standards and the specific quality requirements needed for the measurement task

S3.7: Assess repeatability and reproducibility of measurements to determine any variation within the data and establish a degree of confidence

S3.11: Present data/results in the most appropriate format to meet customer requirements (for example, production of reports and other measurement documentation)

S4.5: Discuss measurement results and issues with peers to determine when issues need to be escalated

Performance outcome coverage

Assignment 1

Task	PO1	PO2	PO3	PO4	Total
1	12	13	0	2	27
2	6	5	5	0	16
3	0	0	17	7	24
Total marks	18	18	22	9	67
% weighting	26.87%	26.87%	32.84%	13.43%	100.01%

Assignment 2

Task	PO1	PO2	PO3	PO4	Total
1	27	2	0	0	29
2	0	26	0	10	36
3	0	0	29	10	39
Total marks	27	28	29	20	104
% weighting	25.96%	26.92%	27.88%	19.23%	99.99%

Assignment 3

Task	PO1	PO2	PO3	PO4	Total
1	4	2	6	0	12
2	14	2	6	0	22
3	10	4	5	10	29
Total marks	28	8	17	10	63
% weighting	44.4%	12.7%	27.0%	15.9%	100%

Document information

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

Owner: Head of Assessment Design

Change History Record

Version	Description of change	Approval	Date of Issue
v1.0	Post approval, updated for publication.		January 2021
v1.1	NCFE rebrand.		September 2021
v1.2	OS review Feb 23		February 2023
v1.3	Sample added as a watermark	November 2023	21 November 2023