



Australian Government

MSL975016 Perform complex tests to measure engineering properties of materials

Release: 1

MSL975016 Perform complex tests to measure engineering properties of materials

Modification History

Release 1. Supersedes and is equivalent to MSL975016A Perform complex tests to measure engineering properties of materials

Application

This unit of competency covers the ability to prepare test specimens and perform multi-stage mechanical tests on them. The unit requires personnel to create test conditions that suit the materials intended use, optimise measurement procedures and recognise critical measurement points during the tests. The unit also covers data analysis and troubleshooting procedures/equipment that have led to atypical data or results.

This unit of competency is applicable to laboratory personnel in the construction materials, mining and manufacturing industry sectors.

While no specific licensing or certification requirements apply to this unit at the time of publication, laboratory operations are governed by relevant legislation, regulations and/or external accreditation requirements. Local requirements should be checked.

Pre-requisite Unit

MSL974012 Perform tests to determine the properties of construction materials

MSL973010 Conduct laboratory-based acceptance tests for construction materials

Competency Field

Testing

Unit Sector

Elements and Performance Criteria

Elements describe the essential outcomes.

Performance criteria describe the performance needed to demonstrate achievement of the element.

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| 1 Interpret and schedule test requirements | 1.1 Review test request and sample documentation to identify required test parameters and intended use of bulk material |
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| | | 1.2 | Identify hazards and workplace control measures associated with the sample, preparation/testing methods and equipment |
| | | 1.3 | Inspect samples, compare with specifications, record and report discrepancies |
| | | 1.4 | Liaise with client when samples and/or request forms do not comply with workplace procedures |
| | | 1.5 | Match required parameters with suitable test methods, available equipment and instrument specifications |
| | | 1.6 | Plan parallel work sequences to optimise throughput of multiple sets of samples, as required |
| 2 | Prepare and measure test specimens | 2.1 | Prepare test specimens in accordance with test method |
| | | 2.2 | Conduct preliminary measurements to establish initial dimensions and conditions |
| | | 2.3 | Store test specimens and residual sample materials to maintain their integrity |
| 3 | Check equipment before use | 3.1 | Set up equipment/instruments in accordance with test method |
| | | 3.2 | Perform pre-use and safety checks in accordance with workplace procedures and manufacturer specifications |
| | | 3.3 | Identify faulty or unsafe components and equipment and report to appropriate personnel |
| | | 3.4 | Check calibration status of equipment and quarantine out-of-calibration or faulty items |
| 4 | Test samples | 4.1 | Position and secure test specimen in test equipment/instrument |
| | | 4.2 | Conduct preliminary measurements to determine optimum test conditions and instrument settings |
| | | 4.3 | Perform each measurement stage in sequence, terminating each stage at the appropriate end point |

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| | | 4.4 | Record all test measurements, observations and factors that may impact on quality of results |
| | | 4.5 | Remove test piece and conduct post-test measurements |
| | | 4.6 | Shut down equipment and store used test pieces in accordance with workplace procedures |
| 5 | Process and analyse data | 5.1 | Confirm data is the result of valid measurements |
| | | 5.2 | Perform required calculations and ensure results are consistent with estimations and expectations |
| | | 5.3 | Record results with the appropriate accuracy, precision and units |
| | | 5.4 | Estimate and document uncertainty of measurement in accordance with workplace procedures, if required |
| | | 5.5 | Analyse trends in data and/or results and report out-of-specification or atypical results promptly to appropriate personnel |
| | | 5.6 | Troubleshoot procedure or equipment problems which have led to atypical data or results |
| 6 | Maintain a safe work environment | 6.1 | Use established safe work practices to ensure personal safety and that of other laboratory personnel |
| | | 6.2 | Minimise the generation of wastes and environmental impact |
| | | 6.3 | Ensure the safe disposal of laboratory wastes |
| | | 6.4 | Clean, care for and store equipment and consumables in accordance with workplace procedures |
| 7 | Maintain laboratory records | 7.1 | Enter approved data and results into laboratory information management system (LIMS) |
| | | 7.2 | Maintain security and confidentiality of workplace information and laboratory data |
| | | 7.3 | Maintain equipment and calibration logs in accordance |

with workplace procedures

Foundation Skills

This section describes those language, literacy, numeracy and employment skills that are essential to performance.

Foundation skills essential to performance are explicit in the performance criteria of this unit of competency.

Range of Conditions

This field allows for different work environments and conditions that may affect performance. Essential operating conditions that may be present (depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts) are included.

Standards, codes, procedures and/or workplace requirements

Standards, codes, procedures and/or workplace requirements include the latest version of one or more of:

- Australian and international standards covering the requirements for the competence of testing and calibration laboratories, laboratory safety, quality and environmental management, and uncertainty of measurement
- national work health and safety (WHS) standards and codes of practice, national measurement regulations and guidelines, and environmental legislation and regulations
- standard methods for sampling and testing construction materials, such as soils, aggregates, concrete and asphalt
- specific codes, guidelines, procedures and methods, such as:
 - AustRoads test methods, and State/Territory Road Authority test methods
 - National Association of Testing Authorities (NATA) supplementary requirements for the relevant field of testing, and NATA technical notes and guides
- workplace documents, such as standard operating procedures (SOPs); quality and equipment manuals; calibration and maintenance schedules; material safety data sheets (MSDS) and safety procedures; material, production and product specifications; production and laboratory schedules; workplace recording and reporting procedures; waste minimisation and safe disposal procedures; maps and site plans
- sampling and testing procedures for specific sites, clients and samples

Preparation of samples

Preparation of samples includes, but is not limited to, one or more of:

- moisture conditioning and compaction of soil
- trimming to required size and shape
- orientation of test pieces
- polishing
- curing concrete test pieces

Test methods and procedures

Test methods and procedures include, but are not limited to, one or more of:

- consolidation of soil (e.g. one-dimensional and triaxial)
- shear testing of soil and rock (e.g. total stress, effective stress, direct stress and triaxial stress)
- permeability of soil, rock and concrete (e.g. falling head and constant head)
- California Bearing Ratio (CBR) (4 point)
- fatigue and creep of metals, polymers and concrete
- wheel tracking in asphalt
- stiffness and creep of asphalt

Safe work procedures Safe work procedures include, but are not limited to, one or more of:

- ensuring access to service shut-off points
- recognising and observing hazard warnings and safety signs/barriers
- using machinery guards
- labelling of samples, reagents and hazardous materials
- cleaning equipment and work areas regularly using workplace procedures
- handling and storing hazardous material and equipment in accordance with labels, MSDS, manufacturer instructions, and workplace procedures and regulations
- following established manual handling procedures for tasks involving manual handling
- use of personal protective equipment (PPE), such as hard hats, hearing protection, gloves, goggles, safety glasses, coveralls, respirators and safety boots
- reporting abnormal emissions, discharges and airborne contaminants, such as noise, light, solids, liquids, water/wastewater, gases, smoke, vapour, fumes, odour and particulates, to appropriate personnel

WHS and environmental management requirements

WHS and environmental management requirements include:

- complying with WHS and environmental management requirements at all times, which may be imposed through state/territory or federal legislation. These requirements must not be compromised at any time
- applying standard precautions relating to the potentially hazardous nature of samples

Unit Mapping Information

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Links

Companion Volume implementation guides are found in VETNet -

<https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=5c63a03b-4a6b-4ae5-9560-1e3c5f462baa>

Assessment Requirements for MSL975016 Perform complex tests to measure engineering properties of materials

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Performance Evidence

Evidence of competence in this unit must satisfy all of the requirements of the elements and performance criteria, and include demonstration of:

- safely preparing at least three (3) different test specimens and performing complex, multi-stage mechanical tests on them
- accurately interpreting client requests, complex tests and sample preparation methods, and safety information
- planning work sequences involving multiple/parallel tasks
- selecting test methods, operating parameters and test ranges to suit the material and its intended use
- creating test conditions that suit the material's intended use
- preparing and orientating test pieces precisely
- safely setting up, checking and using, cleaning and maintaining equipment in accordance with workplace procedures
- optimising measurement procedures and recognising critical measurement points during the tests
- maintaining close attention to measurement procedures, accuracy and precision during lengthy complex tests
- calculating and determining required engineering properties with appropriate accuracy, precision and units (e.g. total and effective stress, strain and pressure)
- using calibration charts
- recording and reporting data and results accurately and legibly in accordance with workplace procedures
- interpreting significant features of data and graphs and making logical conclusions
- recognising atypical data, errors and unexpected results and tracing artefacts and troubleshooting problems with procedures or equipment
- maintaining security, integrity and traceability of all samples, test pieces and documentation
- seeking timely advice from a supervisor
- communicating with clients or outside service technician in accordance with workplace procedures
- minimising environmental impacts, including safe collection, storage and appropriate disposal of waste.

Knowledge Evidence

Must provide evidence that demonstrates knowledge of:

- details of complex, multi-stage mechanical test methods routinely used in job role, including:
 - purpose and principles of test
 - relationship between the engineering properties and uses of construction materials
 - key sample preparation stages
 - key treatment and measurement stages
 - calculation steps to give results in appropriate units and precision
 - expected values for sample type
 - sources of uncertainty and methods for their control
- principles and concepts underpinning test methods, such as:
 - stress, strain, pressure, total and effective stress, fatigue, creep, failure modes of materials, strength/consolidation of materials and permeability
 - electrical safety concepts, including voltage, current, resistance, conductors/insulators and AC/DC
- principles and concepts related to equipment/instrument operation and testing, including the function of key components and effects on test of modifying variables
- pre-use checks and operating procedures for test equipment/instruments routinely used in job role
- basic equipment and method troubleshooting procedures
- workplace and legal traceability requirements for samples, test pieces, test data and results
- procedures for recording and reporting test results, calculations, test observations and unexpected or atypical results and equipment problems
- confidentiality requirements
- hazards associated with construction material testing, relevant work health and safety (WHS) and environmental management requirements.

Assessment Conditions

- Judgment of competence must be based on holistic assessment of the evidence. Assessment methods must confirm consistency of performance over time, rather than a single assessment event.
- This unit of competency is to be assessed in the workplace or a simulated workplace environment. A simulated workplace environment must reflect realistic operational workplace conditions that cover all aspects of workplace performance, including the environment, task skills, task management skills, contingency management skills and job role environment skills.
- Foundation skills are integral to competent performance of the unit and should not be assessed separately.
- Assessment processes and techniques must be appropriate to the language, literacy and numeracy requirements of the work being performed and the needs of the candidate.

- Knowledge evidence may be collected concurrently with performance evidence or through an independent process, such as workbooks, written assessments or interviews (provided a record is kept in each case).
- This unit of competency may be assessed with:
 - MSL925001 Analyse data and report results
- Holistic assessment methods include:
 - review of test data, results, records and workplace documentation generated by the candidate
 - feedback from supervisors and clients regarding the candidate's ability to conduct a range of complex, multi-stage mechanical tests reliably, safely and efficiently
 - observation of candidate conducting a range of complex tests on engineering materials
 - oral or written questioning about workplace procedures and complex, multi-stage mechanical test methods relevant to job role.
- Access is required to instruments, equipment, materials, workplace documentation, procedures and specifications associated with this unit, including, but not limited to:
 - an engineering materials testing laboratory with appropriate test equipment, instruments and samples as specified in the test methods
 - test methods and description of test set-up, data sets and technical/administrative records, and workplace procedures
 - calculator and/or computer and relevant software or laboratory information management system (LIMS).
- Assessors must satisfy the assessor competency requirements that are in place at the time of the assessment as set by the VET regulator.
- The assessor must demonstrate both technical competence and currency.
- Technical competence can be demonstrated through:
 - relevant VET or other qualification/Statement of Attainment AND/OR
 - relevant workplace experience.
- Currency can be demonstrated through:
 - performing the competency being assessed as part of current employment OR
 - having consulted with a laboratory about performing the competency being assessed within the last twelve months.

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