



Australian Government

Department of Education, Employment and Workplace Relations

PMLTEST520A Perform complex tests to measure engineering properties of materials

Release: 1

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Modification History

Unit Descriptor

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 has the following prerequisite(s):

PMLTEST411A Perform mechanical tests.

This unit of competency is applicable to laboratory personnel in the construction materials industry sector.

Industry representatives have provided case studies to illustrate the practical application of this unit of competency and to show its relevance in a workplace setting, at the end of this unit of competency under the section "This competency in practice".

Application of the Unit

Licensing/Regulatory Information

Pre-Requisites

Employability Skills Information

Elements and Performance Criteria Pre-Content

Elements describe the essential outcomes of a unit of competency.

Performance criteria describe the level of performance required to demonstrate achievement of the element.

Elements and Performance Criteria

Elements and Performance Criteria

Element	Performance Criteria
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 1.2 Identify hazards and enterprise control measures associated with the sample, preparation/testing methods and equipment 1.3 Inspect sample(s), compare with specifications, record and report discrepancies 1.4 Liaise with client when samples and/or request forms do not comply with enterprise 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 enterprise procedures and manufacturers 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
 - 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 enterprise 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 Analyse trends in data and/or results and report "out of specification" or atypical results promptly to appropriate personnel
 - 5.5 Trouble shoot 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 enterprise procedures

- 7 Maintain laboratory records
 - 7.1 Enter approved data and results into laboratory information management system
 - 7.2 Maintain security and confidentiality of enterprise information and laboratory data
 - 7.3 Maintain equipment and calibration logs in accordance with enterprise procedures.

Required Skills and Knowledge

Evidence Guide

The Evidence Guide describes the underpinning knowledge and skills that must be demonstrated to prove competence.

Critical aspects of competency

Competency must be demonstrated in the ability to perform consistently at the required standard. In particular, assessors should look to see that the candidate:
selects test methods, operating parameters and test ranges to suit the material and its intended use

prepares and orients test pieces precisely

safely sets up, starts up and shuts down equipment

maintains close attention to measurement procedures, accuracy and precision during lengthy complex tests

calculates/determines required engineering properties with appropriate accuracy, precision and units

recognises atypical data/results and traces artefacts and problems with procedures or equipment

records and reports data/results in accordance with enterprise procedures

maintains security, integrity and traceability of all samples, test pieces and documentation.

Underpinning knowledge

Competency includes the ability to apply and explain:

principles and concepts underpinning test procedure such as:

stress, strain, pressure including total and effective stress

properties of materials

failure modes of materials

application of results to engineering design and construction

sample preparation procedures

principles and concepts related to equipment/instrument operation and testing

function of key components of the equipment/instrument

effects on test of modifying equipment/instrument variables

basic equipment/method troubleshooting procedures

use of calibration charts

calculation steps to give results in appropriate units and precision

enterprise and/or legal traceability requirements

relevant health, safety and environment requirements.

Assessment context and methods

This unit of competency is to be assessed in the workplace or simulated workplace environment.

The following assessment methods are suggested:

review of results obtained by the candidate over a period of time to ensure accurate and consistent results are obtained within required timelines

inspection of testing records and workplace documentation completed by the candidate

observation of candidate conducting a range of complex tests on engineering materials

feedback from clients, peers and supervisors

oral or written questioning.

In all cases, practical assessment should be supported by questions to assess underpinning knowledge and those aspects of competency which are difficult to assess directly. Questioning techniques should suit the language and literacy levels of the candidate.

Interdependent assessment of unit

This unit of competency may be assessed with:

PMLDATA500B Analyse data and report results.

Resource implications

Resources may include:

engineering materials testing laboratory with appropriate test equipment, instruments and samples, standard operating procedures and test methods.

This competency in practice

Construction materials

A consulting company is investigating a possible dam site and needs to assess a particular soil in the foundation. They request a geotechnical testing authority to determine the permeability of the soil. A laboratory technician checks the client request and inspects the soil sample, noting that it is plastic, clay and fissured. The technician checks the dam design parameters and notes that the overburden pressure will be 500 kPa.

They decide to use a triaxial permeability test using a constant head configuration. The technician trims a cylindrical test piece, determines the sample's bulk density and uses the trimmings to determine its moisture content. The test piece is mounted in a triaxial test cell and the equipment carefully de-aired. All pressure gauges, regulators and transducers are checked and the equipment is leak tested. A confining stress is applied and after allowing the sample to come to equilibrium, it is back saturated. The cell pressure is increased to 500 kPa and as the sample consolidates, the technician monitors the sample volume change and pore water pressure. A differential pressure is applied in stages and the water flow through the sample is optimised. After reaching a steady state the flow rate is monitored to determine the sample permeability.

After taking sufficient readings to ensure a valid measurement, the technician prepares plots of permeability and time and reports the steady state values. After completing the test, the technician shuts down the equipment in the recommended sequence, cleans and restores all items. He/she removes the test piece and determines the after-test moisture content.

Key Competencies

The seven key competencies represent generic skills considered for effective work participation. The bracketed numbering against each of the key competencies indicates the performance level required in this unit. These are stand-alone levels and do not correspond to levels in the Australian Qualifications Framework (AQF).

Level (1) represents the competence to undertake tasks effectively

Level (2) represents the competence to manage tasks

Level (3) represents the competence to use concepts for evaluating and reshaping tasks.

Collecting, analysing & organising information	Communicating ideas & information	Planning & organising activities	Working with others and in teams	Using mathematical ideas and techniques	Solving problems	Using technology
Level 2	Level 2	Level 2	Level	Level 2	Level 3	Level 3

Range Statement

The range of variables relates to the unit of competency as a whole. It allows for different work environments and situations that will affect performance.

Where reference is made to industry codes of practice, and/or Australian/international standards, it is expected the latest version will be used.

All operations must comply with relevant standards, appropriate procedures and/or enterprise requirements. These procedures include or have been prepared from:

Australian and international standards such as:

AS ISO/IEC 17025 General requirements for the competence of testing and calibration laboratories

AS 1289. Methods of testing soils for engineering

AS 1012. Methods of testing concrete

AS 2981. Methods of sampling and testing asphalt

DIN 19683-series Soil testing in agricultural hydrology- Physical laboratory tests

material safety data sheets (MSDs)

standard operating procedures (SOPs)

quality manuals, equipment and procedures manuals

equipment startup, operation and shutdown procedures

calibration and maintenance schedules

enterprise recording and reporting procedures

production and laboratory schedules

material, production and product specifications.

Preparation of samples may include:

moisture conditioning and compaction of soil

trimming to required size and shape

orientation of test pieces

polishing

curing concrete test pieces.

Tests and procedures could include:

consolidation of soil (for example, one-dimensional, triaxial)

shear testing of soil and rock (for example, total stress, effective stress, direct stress, triaxial stress)

permeability of soil, rock and concrete (for example, falling head, constant head)

stability and flow of asphalt

fatigue and creep of metals, polymers and concrete.

Hazards may include:

microbiological organisms and agents associated with soil

chemicals such as acids and solvents

sharps and hand tools

flammable liquids and gases

cryogenics such as dry ice and liquid nitrogen

fluids under pressure such as steam and industrial gases, hydraulics

disturbance or interruption of services

crushing, entanglement, cuts associated with moving machinery or falling objects.

Hazard control measures may include:

ensuring access to service shut off points

recognising and observing hazard warnings and safety signs

labelling of samples, hazardous materials and equipment
machinery guards
handling and storage for hazardous materials and equipment in accordance with labelling,
materials safety data sheets and manufacturer's instructions
identifying and reporting operating problems or equipment malfunctions
cleaning equipment and work areas regularly using enterprise procedures
using personal protective clothing and equipment such as hard hats, hearing protection,
gloves, safety glasses, coveralls and safety boots
following established manual handling procedures
reporting abnormal emissions, discharges and airborne contaminants such as noise, light,
solids, liquids, water/waste water, gases, smoke, vapour, fumes, odour and particulates to
appropriate personnel.

Health, safety and environment

All operations to which this unit applies are subject to stringent health, safety and environmental (HSE) requirements, which may be imposed through State or Federal legislation, and these must not be compromised at any time. Where there is an apparent conflict between performance criteria and HSE requirements, the HSE requirements take precedence.

All operations assume the potential hazardous nature of samples and require standard precautions to be applied. Users should access and apply current industry understanding of infection control issued by the National Health and Medical Research Council and State and Territory Departments of Health. All operations are performed in accordance with standard operating procedures.

Unit Sector(s)