



Australian Government

Department of Education, Employment and Workplace Relations

PMLTEST411A Perform mechanical tests

Release: 1

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Modification History

Unit Descriptor

This unit of competency covers the ability to interpret mechanical test requirements, prepare samples, conduct pre-use and calibration checks on equipment and perform routine mechanical tests. These tests will involve several measurement steps. The unit includes data processing and interpretation of results and tracking of obvious test malfunctions where the procedure is standardised. However, personnel are not required to analyse data, optimise tests/procedures for specific samples or troubleshoot equipment problems where the solution is not apparent.

This unit of competency has no prerequisites.

This unit of competency is applicable to laboratory or technical assistants and instrument operators working in the manufacturing, food and construction materials industry sectors. 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. These are found 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 to identify samples to be tested, test method and equipment/instruments involved 1.2 Identify hazards and enterprise control measures associated with the sample, preparation/test methods and/or equipment 1.3 Plan work sequences to optimise throughput of multiple samples (if appropriate).
2 Receive samples and prepare test-pieces	2.1 Log samples using standard operating procedure 2.2 Record sample description, compare with specification and note and report discrepancies 2.3 Prepare test-pieces (and standards if appropriate) in accordance with mechanical testing requirements 2.4 Ensure traceability of samples from receipt to reporting of results
3 Check equipment before use	3.1 Set up equipment/instruments in accordance with test method requirements 3.2 Perform pre-use and safety checks in accordance with relevant enterprise and operating procedures 3.3 Identify faulty or unsafe components and equipment and report to appropriate personnel 3.4 Check equipment calibration using specified procedures (if applicable) 3.5 Quarantine out-of-calibration equipment/instruments
4 Test samples to determine mechanical properties	4.1 Operate equipment/instruments in accordance with test method requirements 4.2 Perform tests/procedures on all test-pieces and standards (if appropriate) in accordance with specified methods

- 4.3 Shut down equipment/instruments in accordance with operating procedures
- 5 Process and interpret data
 - 5.1 Record test data noting atypical observations
 - 5.2 Ensure calculated values are consistent with expectations
 - 5.3 Record and report results in accordance with enterprise procedures
 - 5.4 Interpret trends in data and/or results and report 'out-of-specification' or atypical results promptly to appropriate personnel
 - 5.5 Determine if obvious procedure or equipment problems have led to atypical data or results
- 6 Maintain a safe work environment
 - 6.1 Use established work practices and personal protective equipment to ensure personal safety and that of other laboratory personnel
 - 6.2 Minimise the generation of wastes and environmental impacts
 - 6.3 Ensure the safe collection of laboratory and hazardous waste for subsequent disposal
 - 6.4 Care for and store equipment, used test-pieces and back-up samples as required
- 7 Maintain laboratory records
 - 7.1 Enter approved data into laboratory information management system
 - 7.2 Maintain confidentiality and security 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:

- interprets test methods/procedures accurately
- prepares and tests samples/test-pieces in accordance with specified methods
- performs calibration checks (if required)
- safely operates test equipment/instruments to enterprise standards and/or manufacturer's specifications
- applies basic knowledge of mechanical properties of materials to interpret gross features of data and make relevant conclusions
- identifies atypical results, such as 'out of normal' range or an artefact
- traces and sources obvious causes of an artefact
- communicates problem(s) to a supervisor or outside service technician
- records and communicates results in accordance with enterprise procedures
- maintains security, integrity and traceability of samples, test-pieces, test data/results and documentation.

Underpinning knowledge

Competency includes the ability to apply and explain:

- mechanical principles and concepts underpinning the test/procedure, such as:
 - matter, interatomic and intermolecular forces, states of matter
 - mass, weight, forces, pressure, energy
 - cohesive/adhesive forces, friction, slip resistance
 - elasticity, hardness, ductility, malleability, strength of materials, elastic limit, elastic moduli, ultimate stress
- electrical concepts, including electric field, voltage, current, resistance, AC/DC)
- use of instruments for qualitative and/or quantitative analysis
- purpose of test(s)
- metrology techniques underpinning test/procedure
- 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
- sample preparation procedures
- basic equipment/method troubleshooting procedures
- use of calibration procedures
- 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 test data/results obtained by the candidate over a period of time to check accuracy, consistency and timeliness of results
review of test records and workplace documentation completed by the candidate
observation of candidate conducting a range of mechanical tests and sample preparation procedures
feedback from peers and supervisors
oral or written questioning of mechanical principles and concepts, test methods and enterprise procedures.

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:

PMLDATA400A Process and interpret data.

Resource implications

Resources may include:

standard laboratory equipped with appropriate test equipment/instruments, standards and materials

enterprise procedures and standard methods.

This competency in practice

Construction materials

A technical assistant is responsible for compressive strength testing of concrete cylinders. Typically, there are 20 to 30 to be tested each day. On arrival in the morning the assistant records the maximum and minimum temperatures of the curing tanks, locates the particular cylinders to be tested and removes them from the tanks. He/she dries each cylinder, weighs it and measures its diameter and length using a comparator gauge. The ends are checked for excessive roughness and non-parallelism. He/she then starts the compression test machine and checks that the load pacer is set to the correct loading rate. He/she places a rubber cap on the finished end of each cylinder in turn and places it centrally on the platen of the load frame. The assistant closes the protective screen, applies load at the specified rate until failure occurs, and records the maximum load. After the cylinder has failed, the assistant removes it from the platen and checks for invalid failure modes. When this occurs (eg. a shear failure) he/she puts the cylinder aside for further investigation. Any debris is removed from the platen and the next cylinder is tested. When all cylinders have been tested, the assistant cleans away any material left on the compression machine and switches it off. He/she enters all the data in into the laboratory information management system (LIMS) which calculates the unit mass and ultimate compressive strength of each cylinder. Finally, the assistant reviews the data for unusual or unexpected results that may indicate an error.

Manufacturing

A technician is asked to test a new polymeric material that is to be used to manufacture children's toys. The technician makes several representative test pieces and measures the elastic properties of the polymer as well as the durability of the polymer to flex many times without cracking. Because the polymer is to be used in a toy, the technician also dispatches samples of the polymer for chemical testing by a consulting laboratory to determine whether any toxic monomer could leach out if a child sucked the toy.

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 and organising information	Communicating ideas and information	Planning and organising activities	Working with others and in teams	Using mathematical ideas and techniques	Solving problems	Using technology
Level 2	Level 1	Level 2	Level 1	Level 2	Level 2	Level 2

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 2243.6 Safety in Laboratories - Mechanical aspects

AS 1012 Methods of testing concrete

AS 1289 Methods of testing soils for engineering purposes

DIN EN ISO 5269 Pulps - Preparation of laboratory sheets for physical testing

ISO 9142 Adhesives

ISO 9000 series Quality management and quality assurance standards

Codes of Practice (such as GLP and GMP)

National Measurement Act

material safety data sheets (MSDSs)

standard operating procedures (SOPs)

quality manuals, equipment and procedures manuals

equipment startup, operation and shutdown procedures

calibration and maintenance schedules

data quality procedures

enterprise recording and reporting procedures

production and laboratory schedules

material, production and product specifications.

Preparation of samples and test-pieces may include processes, such as cutting, trimming or machining of specimens, etching.

Mechanical tests and procedures may include:

adhesive strength

elastic properties and strength of materials

slip resistance, friction

viscosity, torque

creep, endurance

abrasion, hardness, impact, indent, penetration resistance

pressure and/or vacuum testing using manometers, load cells.

Tests may include methods for:

control of starting materials, in-process materials and finished products

investigation of sources of construction materials

basic troubleshooting of enterprise processes.

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
sources of ignition
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 and hazardous materials
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.
Records may include:
test and calibration results
equipment use, maintenance and servicing history
faulty or unsafe equipment.

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)