Australian Government

Department of Education, Employment and Workplace Relations

PMLTEST404A Perform chemical tests and procedures

Release: 1

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Modification History

Unit Descriptor

This unit of competency covers the ability to interpret chemical test requirements, prepare samples, conduct pre-use and calibration checks on equipment and perform routine chemical tests/procedures. 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 is based on, and is equivalent to, the unit **PMLTEST401A Perform instrumental tests/procedures.**

This unit of competency has no prerequisites.

This unit of competency is applicable to laboratory or technical assistants and instrument operators in all 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, reagents and/or equipment
	1.3 Plan work sequences to optimise throughput of multiple samples (if appropriate)
2 Receive and prepare samples	2.1 Log samples using standard operating procedure
	2.2 Record sample description, compare with specification and note and report discrepancies
	2.3 Prepare samples and standards in accordance with chemical 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 standards and procedures (if applicable)
	3.5 Quarantine out-of-calibration equipment/instruments
	3.6 Ensure reagents required for the test are available and meet quality requirements
4 Test samples to determine chemical species or properties	4.1 Operate equipment/instruments in accordance with test method requirements
	4.2 Perform tests/procedures on all samples 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 Construct calibration graphs (if appropriate) and compute results for all samples from these graphs
		5.3 Ensure calculated values are consistent with expectations
		5.4 Record and report results in accordance with enterprise procedures
		5.5 Interpret trends in data and/or results and report 'out-of-specification' or atypical results promptly to appropriate personnel
		5.6 Determine if obvious procedure or equipment problems have led to atypical data or results
6	Maintain a safe work environment	6.1 Use established safe 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 and reagents 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 using procedures appropriate to the nature of sample

performs calibration checks (if required)

safely operates test equipment/instruments to enterprise standards and/or manufacturer's specification

prepares calibration graphs and calculates results using appropriate units and precision

applies basic theoretical knowledge to interpret gross features of data and makes relevant conclusions

identifies atypical results 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, traceability of samples, sub-samples, test data and results and documentation.

Underpinning knowledge

Competency includes the ability to apply and explain:

chemical principles and concepts underpinning test/procedure, such as:

ions, atoms, molecules, bonding and links to chemical properties

chemical reactions involving acid/base, redox, complex ion formation, solubility and equilibrium

energy levels, absorption/emission spectra

use of instruments for qualitative and/or quantitative analysis

purpose of the test(s)

metrology and/or separation techniques underpinning test/procedure

principles and concepts related to equipment/instrument operation and testing

function of key components of the equipment/instrument and/or reagents

effects of modifying equipment/instrument variables

sample preparation procedures

reagent maintenance and evaluation 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 chemical tests and procedures and sample preparation
feedback from peers and supervisors
oral or written questioning of chemical 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
PMLTEST402B Prepare, standardise and use solutions.

Resource implications

Resources may include:
standard laboratory equipped with appropriate test equipment/instruments, standards and reagents
enterprise procedures and standard methods.

This competency in practice

Manufacturing

Ultraviolet spectroscopy is a suitable method for determining the concentration of sulphanilamide in pharmaceutical preparations. The ultraviolet absorption spectrum is pH dependent, with the wavelength maximum different in acid and alkaline solutions. Example: a technician was conducting an analysis and noted that the wavelength maxima had moved from approximately 250nm to below 230nm. After reviewing the procedure being used and checking for possible errors, the technician found that an incorrect solvent had been used for the analysis. The hydrochloric acid solvent was replaced with sodium hydroxide, as per the standard method, and the correct absorption spectrum was obtained.

Environmental

A technician was asked to test water samples from a local lake over several days to determine the lake's nutrient levels following reports of algal blooms in the lake over the preceding weeks. He/she used a field colorimeter kit to determine both nitrates and orthophosphates using standard operating procedures (SOPs). Because the same colorimetric cells were used for the nitrate and orthophosphate tests, they were carefully washed and rinsed with distilled water between all tests (as specified in the SOP). After reviewing the results from the first three days, the technician noted that the first orthophosphate result, which was done immediately after all the nitrate tests, was much higher than subsequent orthophosphate tests which were all consistently low. The technician argued that the 'high' results for the first orthophosphate test may be due to cross contamination from trace amounts of reagents used in previous nitrate tests despite having closely followed the cleaning/rinsing SOPs. After discussion with his/her supervisor, the technician modified the field procedures by using totally different colorimetric cells for the nitrate and orthophosphate tests. For all subsequent tests no 'high' orthophosphate results were obtained for the first sample. As a result, the laboratory supervisor amended the SOPs to incorporate this new requirement.

Food processing

Regular checks are conducted on the percentage of salt in cheese at a dairy company's laboratory. A technician checks the results from the airomatic salt-titration equipment and, if the results are abnormal, notifies the supervisor before taking appropriate action. After obtaining a high result, for example, the assistant notified the supervisor and then began checking the machine to identify a possible reason for the high reading. He/she found that the supply bottle of silver nitrate used in the test was almost empty. This had resulted in less solution being pumped through the equipment than required, leading to graph readings that indicated a high percentage of salt. After replacing the silver nitrate bottle and recalibrating the equipment, the assistant retested the cheese samples and found that they contained the expected 1-2% salt.

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
ISO 9000 series Quality management and quality assurance standards
AS 2243.2 Safety in Laboratories - Chemical aspects
AS 2830.1 Good laboratory practice - Chemical analysis
AS 2162.1 General - Volumetric glassware
AS 2134.1 Flame atomic absorption spectrometry
AS 3753 Recommended practice for chemical analysis by ultraviolet/visible spectrophotometry
industry methods, such as RACI and/or AACC methods for inorganic constituents
Codes of Practice (such as GLP and GMP)
National Measurement Act
material safety data sheets (MSDSs)
standard operating procedures (SOPs)
quality manuals and equipment and procedure 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 may include processes, such as grinding, mulling, preparation of discs, digestion, dissolving, ashing, refluxing, extracting, filtration, evaporation, flocculation, precipitation, washing, drying and centrifugation.
Non instrumental test/procedures may include:
gravimetric analysis, such as:
loss on drying
suspended solids
ashes, such as sulphated and gravimetric assays (for example, sulphates and nitrogen in fertilisers)
Ni by dimethylglyoxime
bitumen content of asphaltic concrete
titrimetric analysis, such as:
acid/base determinations
complexiometric, such as water hardness, Fe by dichromate, binder content analysis
redox, such as precipitation of chlorides in water
dissolved oxygen (DO), chemical oxygen demand (COD), biochemical oxygen demand (BOD)
filtration, separation, solvent extraction techniques

corrosion testing, cement content, accelerated weathering.
Instrumental tests may include spectrometric, chromatography and electrochemical methods.
Types of instrumentation and instrumental techniques may include:
colorimetric, such as enzyme activity, chlorine in water, specific cations and anions
infrared, ultraviolet and visible spectrophotometry
other spectrometric techniques, such as:
fluorimetric analysis, flame atomic emission, flame atomic absorption spectrometry
fourier transform infrared
chromatographic techniques, such as:
column and thin layer analytical and preparative chromatography
paper, gas, liquid chromatography and HPLC for purity, raw material and formulation checks
ion chromatography for detection of nitrates, phosphates, sulphates, chlorides, bromides
gel filtration chromatography for purification of proteins
affinity chromatography for purification of immunoglobulins
electrochemical techniques, such as: pH, eH, conductivity, ion selective electrodes
electrophoretic techniques for DNA patterns and determination of protein purity
soil testing, such as:
moisture content
organic matter content
specific anions and cations
autoanalysers for determination of total P, total Kjeldahl N, orthophosphate, nitrite/nitrate, ammonia.
Chemical tests may include methods for:
control of starting materials, in-process materials and finished products
environmental monitoring
basic troubleshooting and/or problem solving within the scope of standard operating procedures (SOP) and enterprise processes.
Hazards may include:
chemicals, such as:
acids, for example, sulphuric, perchloric, hydrofluoric
heavy metals, pesticides
anions, for example, fluoride
hydrocarbons, for example, mono-aromatics
aerosols from broken centrifuge tubes, pipetting
sharps, broken glassware
flammable liquids and gases
cryogenics, such as dry ice and liquid nitrogen
fluids under pressure, such as hydrogen in gas liquid chromatography, acetylene in atomic absorption spectrometry
sources of ignition
high-temperature ashing processes
disturbance or interruption of services.
Hazard control measures may include:
ensuring access to service shut-off points
recognising and observing hazard warnings and safety signs
labelling of samples, reagents, aliquoted samples and hazardous materials
handling and storage of 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 and decontaminating equipment and work areas regularly using enterprise procedures
using personal protective clothing and equipment, such as gloves, safety glasses, coveralls
using containment facilities (PCII, PCIII and PCIV physical containment laboratories), containment equipment (biohazard containers, laminar flow cabinets, Class I, II and III biohazard cabinets) and containment 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)