Australian Government

Department of Education, Employment and Workplace Relations

MSL974003A Perform chemical tests and procedures

Revision Number: 1

MSL974003A Perform chemical tests and procedures

Modification History

Not applicable.

Unit Descriptor

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.

Application of the Unit

Application of the unit	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'.

Licensing/Regulatory Information

Not applicable.

Pre-Requisites

Prerequisite units		

Employability Skills Information

Employability skills	This unit contains employability skills.

Elements and Performance Criteria Pre-Content

Elements describe the essential outcomes of a unit of competency.	Performance criteria describe the performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge section and the range statement. Assessment of performance is to be consistent with the evidence guide.

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 procedures (SOPs) 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

ELEMENT	PERFORMANCE CRITERIA
	enterprise procedures 5.5. Estimate and document uncertainty of measurement in accordance with enterprise procedures, if required 5.6. Interpret trends in data and/or results and report out of specification or atypical results promptly to appropriate personnel 5.7. 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

REQUIRED SKILLS AND KNOWLEDGE

This section describes the skills and knowledge required for this unit.

Required skills

Required skills include:

- interpreting test methods and procedures
- sample preparation procedures
- performing calibration checks
- using instruments for qualitative and/or quantitative analysis
- maintaining and evaluating reagents
- troubleshooting basic equipment/method
- using calculation methods, including appropriate units, uncertainties, balancing equations, and the concentration of the solution given the chemical reaction for the titration
- preparing calibration graphs and calculating results using appropriate units and precision
- applying theoretical knowledge to interpret gross features of data and make relevant conclusions such as identifying atypical results as out of normal range or an artefact
- tracing and sourcing obvious causes of an artefact
- recording and communicating results in accordance with enterprise procedures
- maintaining security, integrity, traceability of samples, sub-samples, test data, results and documentation

Required knowledge

Required knowledge includes:

- chemical principles and concepts underpinning test/procedure
- purpose of the tests
- concepts of metrology
- 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
- use of calibration procedures
- enterprise and/or legal traceability requirements
- relevant health, safety and environment requirements

Evidence Guide

EVIDENCE GUIDE	
The Evidence Guide provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge, range statement and the Assessment Guidelines for the Training Package.	
Overview of assessment	
Critical aspects for assessment and evidence required to demonstrate competency in this unit	Assessors should ensure that candidates can: • interpret test methods/procedures accurately • prepare and test samples using procedures appropriate to the nature of sample • perform calibration checks (if required) • safely operate test equipment/instruments to enterprise standards and/or manufacturer's specification • prepare calibration graphs and calculate results using appropriate units and precision • apply basic theoretical knowledge to interpret gross features of data and make relevant conclusions • identify atypical results as out of normal range or an artefact • traces and source obvious causes of an artefact • communicate problems to a supervisor or outside service technician • record and communicate results in accordance with enterprise procedures • maintain security, integrity, traceability of samples, sub-samples, test data and results and documentation.
Context of and specific resources for assessment	This unit of competency is to be assessed in the workplace or simulated workplace environment. This unit of competency may be assessed with: • *MSL924001A Process and interpret data* • *MSL974001A Prepare, standardise and use solutions*. Resources may include: • standard laboratory equipped with appropriate test equipment/instruments, standards and reagents • enterprise procedures and standard methods.
Method of assessment	The following assessment methods are suggested: • review of test data/results obtained by the candidate

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	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. Where applicable, reasonable adjustment must be made to work environments and training situations to accommodate ethnicity, age, gender, demographics and disability. Access must be provided to appropriate learning and/or assessment support when required. The language, literacy and numeracy demands of assessment should not be greater than those required to undertake the unit of competency in a work like environment.
This competency in practice	Industry representatives have provided the case studies below to illustrate the practical application of this unit of competency and to show its relevance in a workplace setting. **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.

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	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 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.

Range Statement

RANGE STATEMENT	
The range statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance. Bold italicised wording, if used in the performance criteria, is detailed below. Essential operating conditions that may be present with training and assessment (depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts) may also be included.	
Codes of practice	Where reference is made to industry codes of practice, and/or Australian/international standards, it is expected the latest version will be used

Standards, **codes**, **procedures and/or enterprise requirements**	Standards, codes, procedures and/or enterprise requirements may include:
	• Australian and international standards, such as:
	  • AS 2134.1-1999 Recommended practice for chemical analysis by atomic absorption spectrometry - Flame atomic absorption spectrometry
	  • AS 2162.1-1996 Verification and use of volumetric apparatus - General - Volumetric glassware
	  • AS 3753-2001 Recommended practice for chemical analysis by ultraviolet/visible spectrophotometry
	  • AS ISO 1000-1998 The international system of units (SI) and its application
	  • AS ISO 17025-2005 General requirements for the competence of testing and calibration laboratories
	  • AS/NZS 2243 Set:2006 Safety in laboratories set
	  • AS/NZS ISO 9000 Set:2008 Quality management systems set
	• Australian code of good manufacturing practice for medicinal products (GMP)
	• calibration and maintenance schedules
	• enterprise recording and reporting procedures
	• equipment manuals
	• equipment startup, operation and shutdown procedures
	• industry methods, such as Royal Australian

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	Chemical Institute (RACI) and/or American Association of Cereal Chemists (AACC) methods for inorganic constituents • material safety data sheets (MSDS) and safety procedures • material, production and product specifications • national measurement regulations and guidelines • principles of good laboratory practice (GLP) • production and laboratory schedules • quality manuals and equipment and procedure manuals • SOPs • waste minimisation and safe disposal procedures
Sample preparation processes	Sample preparation processes may include: • grinding • mulling • preparation of discs • digestion • dissolving • ashing • refluxing • tracting • filtration • evaporation • flocculation • precipitation • washing • drying • centrifugation

Non-instrumental test/procedures	Non-instrumental test/procedures may include:
	• gravimetric analysis:
	  • loss on drying
	  • suspended solids
	  • ashes, such as sulphated and gravimetric assays (e.g. sulphates and nitrogen in fertilisers)
	  • Ni by dimethylglyoxime
	  • bitumen content of asphaltic concrete

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	• titrimetric analysis:
	  • acid/base determinations
	  • complexiometric, such as water hardness, Fe by dichromate and binder content analysis
	  • redox, such as precipitation of chlorides in water
	  • dissolved oxygen (DO), chemical oxygen demand (COD) and biochemical oxygen demand (BOD)
	• filtration, separation and solvent extraction techniques
	• corrosion testing, cement content and accelerated weathering

Instrumental tests	Instrumental tests may include: • spectrometry • chromatography • electrochemistry

Types of instrumentation and instrumental techniques	Types of instrumentation and instrumental techniques may include:
	• colorimetric techniques, such as enzyme activity, chlorine in water, specific cations and anions
	• infrared, ultraviolet-visible (UV-VIS) spectrophotometry
	• other spectrometric techniques:
	  • fluorimetric analysis, flame atomic emission and flame atomic absorption spectrometry
	  • fourier transform infrared
	• chromatographic techniques:
	  • column and thin layer analytical and preparative chromatography
	  • gas or liquid chromatography for purity, raw material and formulation checks
	  • ion chromatography for detection of nitrates, phosphates, sulphates, chlorides and bromides
	  • gel filtration chromatography for purification of proteins

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	• electrochemical techniques, such as pH, eH, conductivity and ion-selective electrodes
	• electrophoretic techniques for DNA patterns and determination of protein purity
	• soil testing:
	  • moisture content
	  • organic matter content
	  • specific anions and cations
	• auto-analysers for determination of total P, total Kjeldahl N, orthophosphate, nitrite/nitrate and ammonia

Chemical principles and concepts	Chemical principles and concepts may include: • ions, atoms, molecules, bonding and links to chemical properties • chemical reactions involving acid/base, redox, complex ion formation, solubility and equilibrium • energy levels and absorption/emission spectra
Chemical tests methods	Chemical tests methods may include: • control of starting materials, in-process materials and finished products • environmental monitoring • basic troubleshooting and/or problem solving within the scope of SOPs and enterprise processes

Hazards	Hazards may include:
	• chemicals:
	  • acids (e.g. sulphuric, perchloric and hydrofluoric)
	  • heavy metals and pesticides
	  • anions (e.g. fluoride)
	  • hydrocarbons (e.g. mono-aromatics)
	• aerosols from broken centrifuge tubes, pipetting
	• sharps and 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

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	absorption spectrometry • sources of ignition • high-temperature ashing processes • disturbance or interruption of services
Hazard control measures:	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, MSDS 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 and 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	Records may include: • test and calibration results • equipment use, maintenance and servicing history • faulty or unsafe equipment
Occupational health and safety (OHS) and environmental management requirements	OHS and environmental management requirements: • all operations must comply with enterprise OHS and environmental management

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	requirements, which may be imposed through state/territory or federal legislation - these requirements must not be compromised at any time • all operations assume the potentially hazardous nature of samples and require standard precautions to be applied • where relevant, users should access and apply current industry understanding of infection control issued by the National Health and Medical Research Council (NHMRC) and State and Territory Departments of Health

Unit Sector(s)

Unit sector	Testing

Competency field

Competency field	

Co-requisite units

Co-requisite units		