



Australian Government

MSL975019A Apply complex instrumental techniques

Revision Number: 1

MSL975019A Apply complex instrumental techniques

Modification History

Not applicable.

Unit Descriptor

Unit descriptor	This unit of competency covers the ability to analyse samples using specialised analytical instruments that require highly developed technical skills to operate effectively. Competency includes the ability to establish client needs for routine and non-routine samples, optimising enterprise procedures and instruments for specific samples, obtaining valid and reliable data and reporting test results. Personnel are required to recognise atypical test data/results and troubleshoot common analytical procedure and equipment problems.
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Application of the Unit

Application of the unit	This unit of competency is applicable to technical officers working in all industry sectors, government agencies and research laboratories. All operations and analytical methods must comply with relevant standards, appropriate procedures and/or enterprise requirements. Although a supervisor may not always be present, the technical officer will follow standard operating procedures (SOPs) that clearly describe the scope of permitted practice including varying enterprise/test procedures and communicating results to people outside the laboratory. 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'.
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Licensing/Regulatory Information

Not applicable.

Pre-Requisites

Prerequisite units		
	MSL975009A	Apply routine chromatographic techniques OR
		OR
	MSL975020A	Apply routine spectrometric techniques AND
		AND
	MSL974003A	Perform chemical tests OR
		OR
	MSL974004A	Perform food tests OR
		OR
	MSL974006A	Perform biological procedures
	MSL973007A	Perform microscopic examination, and
	MSL973004A	Perform aseptic techniques
		AND
	MSL973002A	Prepare working solutions
		OR
	MSL974001A	Prepare, standardise and use solutions

Employability Skills Information

Employability skills	This unit contains employability skills.
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Elements and Performance Criteria Pre-Content

Elements describe the essential outcomes of a	Performance criteria describe the performance needed to demonstrate achievement of the element. Where bold
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unit of competency.	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.
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Elements and Performance Criteria

ELEMENT	PERFORMANCE CRITERIA
1. Establish client needs and schedule analysis	1.1.Liaise with client or sample provider to determine client needs and sample history 1.2.Record sample description, compare with specification and record and report discrepancies 1.3.Identify non-routine samples and the possible need to vary enterprise procedures 1.4.Seek advice from supervisor about any proposed variations and document all approved changes. 1.5.Schedule analysis using enterprise procedures
2. Prepare samples and standards	2.1.Obtain a representative analytical portion of the laboratory sample 2.2.Prepare sample in accordance with testing requirements 2.3.Prepare validation checks and/or calibration standards for analytical portions 2.4.Use specialised procedures for ultra-trace sample and standard preparation as required
3. Setup, optimise instrument and sub-systems	3.1.Perform pre-use and safety checks using enterprise procedures 3.2.Assemble appropriate instrument sub-systems to construct the required analytical path 3.3.Start up and condition the instrument using enterprise procedures 3.4.Check and optimise each instrument sub-system 3.5.Optimise instrumental parameters to suit sample and test requirements 3.6.Check calibration status of instrument and perform calibration using specified standards and procedures, if applicable
4. Perform analysis	4.1.Measure analyte response for standards, validation checks and samples 4.2.Conduct sufficient measurements to obtain reliable

ELEMENT	PERFORMANCE CRITERIA
	data 4.3.Return instruments to standby or shutdown condition as required
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 standards or estimations and expectations 5.3.Record results with the appropriate accuracy, precision, uncertainty 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.Troubleshoot analytical procedure or equipment problems which have led to atypical data or results
6. Maintain a safe work environment	6.1.Identify risks, hazards, safety equipment and control measures associated with sample handling, preparation and analytical method 6.2.Use personal protective equipment and safety procedures specified for test method and materials to be tested 6.3.Minimise the generation of wastes and environmental impacts 6.4.Ensure the safe disposal of laboratory wastes 6.5.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 (LIMS) 7.2.Maintain equipment logs in accordance with enterprise procedures 7.3.Maintain security, integrity and traceability of samples and documentation 7.4.Communicate results to appropriate personnel

Required Skills and Knowledge

REQUIRED SKILLS AND KNOWLEDGE

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

REQUIRED SKILLS AND KNOWLEDGE

Required skills

Required skills include:

- establishing client needs for routine and non-routine samples
- interpreting client request, test methods and procedures accurately
- preparing samples and standards optimise procedures and equipment to suit sample/test requirements
- safely setting up, starting up and shutting down equipment
- obtaining valid and reliable data
- troubleshooting common analytical procedure and equipment problems
- assembling checks and optimising instrument sub-systems
- checking the calibration/qualification status of equipment
- operating equipment to obtain valid and reliable data
- calculating analyte concentrations with appropriate accuracy, precision, uncertainty and units
- recognising atypical data/results
- applying theoretical knowledge to interpret data and make relevant conclusions
- recording and reporting data/results using enterprise procedures
- maintaining security, integrity and traceability of samples and documentation
- following occupational health and safety (OHS) procedures and principles of good laboratory practice (GLP)

Required knowledge

Required knowledge includes:

- principles and concepts related to instrument operation, material preparation and testing, such as:
 - mechanisms for absorption/emission
 - distinction between selective ion monitoring (SIM) and total ion current (TIC) mode in gas chromatographic mass spectroscopy (GC-MS)
 - sequence of steps required for successful anode stripping voltameter (ASV)
- function of key components and sub-system of the instrument
- handling of hazardous chemicals and samples and/or the fragile/labile nature of biological material
- sample preparation procedures
- effects on outputs and results of modifying instrumental variables
- procedures for optimising instrument performance
- basic procedure and equipment troubleshooting techniques
- preparation and use of calibration charts and/or standards
- calculation steps to give results in appropriate units and precision
- basic equipment maintenance procedures

REQUIRED SKILLS AND KNOWLEDGE

- 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 client request, test methods and procedures accurately
- safely set up, start up and shut down equipment using enterprise procedures
- assemble checks and optimise instrument sub-systems
- check calibration/qualification status of equipment
- prepare samples and standards appropriately
- optimise procedures and equipment to suit sample/test requirements
- operate equipment to obtain valid and reliable data
- calculate analyte concentrations with appropriate accuracy, precision and units
- recognise atypical data/results
- troubleshoot common analytical procedure and equipment problems
- apply theoretical knowledge to interpret data and make relevant conclusions
- record and report data/results using enterprise procedures
- maintain security, integrity and traceability of samples and documentation
- follow OHS procedures and principles of GLP.

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:

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	• <i>MSL925001 Analyse data and report results.</i> Resources may include: • standard laboratory with specialised analytical instruments • laboratory reagents and equipment • SOPs and test methods.
Method of assessment	The following assessment methods are suggested: • review of test data/results obtained by the candidate over time to ensure accuracy, consistency and timeliness of results • inspection of test records and enterprise documentation completed by the candidate • observation of candidate using specialised instruments to measure analytes • feedback from clients, peers and supervisors • oral or written questioning of relevant chemical principles, concepts, analytical techniques 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. Environmental (1) If oysters and other shellfish accumulate significant levels of heavy metals, they can represent a public health risk when consumed by humans. Analysis of heavy metal

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residues requires digestion of the sample in a concentrated acid, typically nitric. The digest is diluted in ultra pure water and analysed by standard addition and electrothermal atomic absorption spectroscopy (AAS) using a phosphate modifier to reduce lead volatility. The technician must pay careful attention to the digestion process and to the widely varying absorbances that will result from oysters of having accumulated different concentrations of residue.

Manufacturing (1)

Electrothermal atomic absorption (AA) spectrophotometers are one of the more common instruments for the analysis of microgram/litre levels of metals. Setting up the instrument requires more skill and care than a normal flame AAS instrument. Firstly, the technician must check the graphite tube for wear, replace it if necessary, and re-align it. The auto sampler delivery tube must also be checked for its alignment so that delivery of the micro-litre aliquots of solution is accurate and precise. The technician must also make the standards with great attention to avoid contamination from glassware and reagents.

Manufacturing (2)

The physical and mechanical properties of metal alloys are crucially dependent on their composition. Therefore, the composition of alloys must be checked carefully. While acid dissolution and analysis by flame AAS or ICP emission spectroscopy is possible, one of the most common techniques used is X-ray fluorescence (XRF) because it does not have the same demanding sample preparation requirements. XRF samples, after polishing to remove any surface defects, can be analysed directly against reference standards of the same alloy. Control of instrument variables is critical in obtaining accurate results. This requires the technician to carefully optimise a number of components within the overall instrument before conducting the analysis.

Environmental (2)

An insurance company contracted a consulting laboratory to conduct tests on an accelerant residue that may have been used in a recent arson attack on a local school building. The residue was run through a column chromatograph and compared with reference standards (such as petrol, kerosene, 50% mixtures, evaporated

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	petrol) to establish the identity of the sample. Confirmation of these results was obtained by using a GC-MS instrument to establish the identity of the sample beyond reasonable doubt along with additional tests for heavy metals such as lead.
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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 2252 Biological safety cabinets
 - 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 2982.1:1997 Laboratory design and construction-General requirements
 - AS/NZS ISO 14000 Set:2005 Environmental management standards set
 - AS/NZS ISO 9000 Set:2008 Quality management systems set
 - AS 2830.1 Good laboratory practice - Chemical analysis
 - AS 2162.1 General - Volumetric glassware
 - AS 2134.1 Flame atomic absorption spectroscopy

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	• ISO/IEC Guide 98-3:2008 Uncertainty of measurement - Part 3 Guide to the expression of uncertainty in measurement (GUM) • Eurachem/CITAC Guide CG4 Quantifying uncertainty in analytical measurement • Australian code of good manufacturing practice for medicinal products (GMP) • calibration and maintenance schedules • cleaning, hygiene and personal hygiene requirements • data quality procedures • enterprise procedures, SOPs and operating manuals • enterprise recording and reporting procedures • equipment startup, operation and shutdown procedures • incident and accident/injury reports • material safety data sheets (MSDS) • material, production and product specifications • national measurement regulations and guidelines • principles of GLP • production and laboratory schedules • quality manuals, equipment and procedure manuals • quality system and continued improvement processes • safety requirements for equipment, materials or products • sampling procedures (labelling, preparation, storage, transport and disposal) • schematics, work flows and laboratory layouts • statutory and enterprise OHS requirements • stock records and inventory • test procedures (validated and authorised) • training program contents • waste minimisation, containment, processing and disposal procedures
Specialised analytical instruments	Specialised analytical instruments may include: • spectrometric instruments such as:

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	• electrothermal (AAS) • vapour generation (AAS) • X-ray fluorescence (XRF) and diffraction (XRD) • nuclear magnetic resonance (NMR), magnetic resonance imaging (MRI) • mass spectrometry (MS) • neutron activation analysis (NAA) • inductively coupled plasma mass spectrometry (ICP-MS) • chromatographic instruments such as: • GC-MS • GC sampling devices (e.g. headspace and thermal desorption) • specialised GC detection devices (e.g. electron capture detector (ECD), flame photometric detector (FPD) and nitrogen phosphorous detection (NPD)) • specialised GC detection devices (e.g. fluorescent, diode array and electrochemical) • liquid chromatography mass spectroscopy (LC-MS), electro-spray MS • gas chromatography fourier transform infra red (GC-FTIR) • electrometric instruments, such as anodic stripping voltammetry • flow injection analytical equipment
Tests requiring specialised instruments	Tests requiring specialised instruments may include: • trace analysis • non-destructive testing • multi-analyte determination • analysis involving high sample throughput
Instrument sub-systems	Instrument sub-systems may include: • sample introduction units and auto sampling equipment • detectors and signal conditioning units • temperature control devices such as cryostats, ovens, and thermostat baths

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	• software control/interface
Sample preparation	Sample preparation may include: • identification of any hazards associated with the samples and/or analytical chemicals • grinding, mulling, preparation of disks, digestion, dissolving, ashing, refluxing, extraction, filtration, evaporation, flocculation, precipitation, washing, drying and centrifugation • solid-phase micro-extraction • determination of, and if appropriate, removal of any contaminants or impurities • ultra-trace procedures requiring high purity solvents, clean rooms, ultra clean glassware and specialised glassware
Common analytical procedure and equipment problems	Common analytical procedure and equipment problems may include: • sample introduction blockages • incomplete atomisation of analyte • poor resolution of peaks • poor sensitivity
Hazards	Hazards may include: • electric shock • biohazards: • microbiological organisms and agents associated with soil, air, water, blood and blood products, and human or animal tissue and fluids • mycotoxins • chemicals: • acids (e.g. sulphuric, perchloric and hydrofluoric) • heavy metals and pesticides • anions (e.g. fluoride) • hydrocarbons (e.g. mono-aromatics) • radiation (alpha, beta, gamma, X-ray and neutron) • sharps and broken glassware • aerosols from broken centrifuge tubes and pipetting

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	• flammable liquids and gases • cryogenics such as dry ice and liquid nitrogen • fluids under pressure such as hydrogen in gas liquid chromatography and acetylene in atomic absorption spectrometry • sources of ignition • high temperature ashing processes • disturbance or interruption of services
Addressing hazards	Addressing hazards may include: • use of MSDS • labelling of samples, reagents, aliquoted samples and hazardous materials • personal protective equipment such as gloves, safety glasses, and coveralls • use of fumehoods, direct extraction of vapours, gases • use of appropriate equipment such as biohazard containers, laminar flow cabinets, Class I, II and III biohazard cabinets • handling and storage of all hazardous materials and equipment in accordance with labelling, MSDS and manufacturer's instructions • minimising exposure to radiation ionising such as lasers, electromagnetic and ultraviolet (UV) radiation
Occupational health and safety (OHS) and environmental management requirements	OHS and environmental management requirements: • all operations must comply with enterprise OHS and environmental management 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
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Competency field

Competency field	
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Co-requisite units

Co-requisite units		