Australian Government

Department of Education, Employment and Workplace Relations

# MSL974001A Prepare, standardise and use solutions

**Revision Number: 1**

# MSL974001A Prepare, standardise and use solutions

## Modification History

Not applicable.

## Unit Descriptor

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| **Unit descriptor** | This unit of competency covers the ability to prepare, standardise and monitor the quality of solutions. |

## Application of the Unit

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| **Application of the unit** | This unit of competency is applicable to laboratory technicians working in all industry sectors.<br><br>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

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| **Prerequisite units** | | |
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# Employability Skills Information

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| **Employability skills** | This unit contains employability skills. |

# Elements and Performance Criteria Pre-Content

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| 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. Prepare solutions | 1.1. Select appropriate procedure for solution preparation<br>1.2. Select equipment, materials and solvent of specified purity<br>1.3. Measure appropriate quantities of reagents for solution preparation and record data.<br>1.4. Select and assemble specified laboratory equipment and appropriate grade of glassware<br>1.5. Perform specified dilutions<br>1.6. Prepare solutions to achieve homogeneous mix of the specified concentration<br>1.7. Label and store solutions to maintain identity and stability |
| 2. Standardise and use volumetric solutions | 2.1. Assemble appropriate laboratory equipment<br>2.2. Perform serial dilutions as required<br>2.3. Standardise the solution to the required specified range and precision<br>2.4. Label and store solutions to maintain identity and stability<br>2.5. Use standard volumetric solutions to determine concentration of unknown solutions |
| 3. Calculate and record data | 3.1. Calculate specified concentrations<br>3.2. Use authorised procedure if data is to be modified<br>3.3. Estimate and document uncertainty of measurement in accordance with enterprise procedures, if required<br>3.4. Record all relevant details according to laboratory procedures and report results<br>3.5. Report concentration with appropriate units |
| 4. Monitor the quality of laboratory solutions | 4.1. Check solutions for visual deterioration and expiry date<br>4.2. Restandardise or dispose of dated or deteriorated solutions<br>4.3. Record details and label solutions according to laboratory procedures |
| 5. Maintain a safe work environment | 5.1. Use established safe work practices and personal protective equipment to ensure personal safety and that of other laboratory personnel<br>5.2. Clean up spills using appropriate techniques to protect personnel, work area and environment<br>5.3. Minimise generation of waste and environmental |

| ELEMENT | PERFORMANCE CRITERIA |
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| | impacts<br>5.4. Ensure the safe collection of laboratory and hazardous waste for subsequent disposal<br>5.5. Store equipment and reagents as required |

# 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 and following enterprise standard operating procedures (SOPs)
- determining equivalence points using indicators and graphical methods
- using calculation methods, including appropriate units, uncertainties, balancing equations, the concentration of the solution given the chemical reaction for the titration
- using apparatus and reagents to prepare standard solutions such as balances and volumetric glassware
- selecting and using primary and secondary standards and indicators
- performingquality assurance checks for solution performance
- performing titrations
- recognising control results that are not within acceptable range
- interpreting and using safety information, such as that provided by material safety data sheets (MSDS) and follow relevant safety procedures

**Required knowledge**

Required knowledge includes:

- solution terminology, chemistry of acids, bases, buffers, redox reactions and complexiometric reactions
- concepts of metrology
- grades of glassware, reagents and their use
- reactions used for standardisation and desirable characteristics
- enterprise communication and reporting procedures
- occupational health and safety (OHS) procedures, including those for using corrosive materials
- relevant health, safety and environment requirements

# Evidence Guide

| **EVIDENCE GUIDE** | |
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| 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:<br>• use balances and volumetric glassware<br>• select and use primary and secondary standards<br>• select and use indicators<br>• perform quality assurance checks for solution performance<br>• perform titrations using laboratory procedures with required accuracy and precision and within required timelines<br>• calculate the concentration of the solution given the chemical reaction for the titration<br>• recognise control results that are not within acceptable range<br>• record results to enterprise standards<br>• label and store solutions in accordance with enterprise procedures<br>• interpret and follow enterprise SOPs<br>• interpret and use safety information, such as that provided by MSDS and follow relevant safety procedures. |
| **Context of and specific resources for assessment** | This unit of competency is to be assessed in the workplace or simulated workplace environment.<br>This unit of competency may be assessed with:<br>• *relevant MSAL974000 series units of competency, and*<br>• *relevant MSAL975000 series units of competency dealing with sampling, tests and measurements*.<br>Resources may include:<br>• standard laboratory equipped with appropriate volumetric equipment<br>• laboratory reagents and equipment<br>• SOPs and testing methods. |
| **Method of assessment** | The following assessment methods are suggested: |

| EVIDENCE GUIDE | |
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| | • inspection and/or testing of solutions prepared by the candidate<br>• review of records and workplace documentation completed by candidate<br>• review of work outputs by the candidate over time to ensure accuracy, consistency and timeliness<br>• feedback from peers and supervisors<br>• observation of the candidate preparing, standardising and using a range of solutions<br>• oral or written questioning.<br><br>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.<br><br>Where applicable, reasonable adjustment must be made to work environments and training situations to accommodate ethnicity, age, gender, demographics and disability.<br><br>Access must be provided to appropriate learning and/or assessment support when required.<br><br>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.<br><br>**Manufacturing**<br><br>A standard solution is used to determine the concentration of unknown solutions. The quality of these analyses is critically related to the accuracy with which the concentration of the standard solution is known. Therefore, laboratory technicians spend considerable effort to ensure that the materials and methods used for the preparation and standardisation will lead to a solution of accurately known concentration. For example, anhydrous sodium carbonate is often used to prepare solutions to determine the concentrations of acids. The sodium carbonate is heated at a suitable temperature to remove any trace of moisture and cooled in a dessicator. An appropriate quantity is dissolved in distilled water |

| EVIDENCE GUIDE | |
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| | and made up to volume in a volumetric flask. This solution of known concentration is then titrated with acids of unknown concentration and the concentration of the acids determined.<br><br>**Environmental**<br><br>A laboratory technician was required to determine the total acidity of a water sample as part of a quality control program. The total acidity was measured by titrating the water sample with sodium hydroxide of known concentration using an appropriate indicator. The concentration of the sodium hydroxide was determined via a volumetric titration against a primary standard of potassium hydrogen phthalate.<br><br>The value of the total acidity was determined by multiplying the volume of sodium hydroxide used with a numerical 'factor' which had been determined by the laboratory supervisor in order to save time. The value of the 'factor' was displayed on the titration equipment. However, a new technical assistant did the full calculation and found that his/her result differed slightly from that obtained using the 'factor'. After discussion with the laboratory supervisor it was agreed that the error was in the 'factor' and the assumption that each new batch of sodium hydroxide prepared was exactly the same concentration as all previous batches. This was incorrect as the concentration of each batch differed slightly and its actual concentration was determined accurate, using the primary standard. The procedure was changed so that the full calculation was required for all tests. |

# Range Statement

| RANGE STATEMENT | |
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| 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:<br>• Australian and international standards, such as:<br>  • AS 2163-2000 Laboratory glassware - Measuring cylinders<br>  • AS 2165-1996 Laboratory glassware - Burettes AS 2162.1-1996 Verification and use of volumetric apparatus - General - Volumetric glassware<br>  • AS ISO 1000-1998 The international system of units (SI) and its application<br>  • AS/NZS ISO 9000 Set:2008 Quality management systems set<br>  • AS ISO 17025-2005 General requirements for the competence of testing and calibration laboratories<br>  • AS/NZS 2243 Set:2006 Safety in laboratories set<br>• Australian code of good manufacturing practice for medicinal products (GMP)<br>• calibration and maintenance schedules<br>• enterprise recording and reporting procedures<br>• equipment manuals<br>• equipment startup, operation and shutdown procedures<br>• MSDS and safety procedures<br>• material, production and product specifications<br>• national measurement regulations and guidelines<br>• principles of good laboratory practice (GLP) |

| RANGE STATEMENT | |
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| | • production and laboratory schedules<br>• quality manuals<br>• SOPs<br>• waste minimisation and safe disposal procedures |
| **Solutions** | Solutions may include but are not limited to:<br>• solutions of strong/weak acids and bases<br>• oxidising/reducing agents<br>• solutions used for complexometric or precipitation titrations<br>• stains for cells and tissues, enzymes, buffers and antibodies<br>• diluents for maintaining isotonicity<br>• organic solutions and histological fixatives |
| **Apparatus and reagents to prepare standard solutions** | Apparatus and reagents to prepare standard solutions may include:<br>• balances<br>• pipettes, burettes, volumetric glassware and weighing bottles<br>• dessicators and filtering media<br>• ovens and muffle furnaces<br>• solutions, indicators and primary and secondary standards<br>• auto titrators, pH meters and other related meters and electrodes for determining equivalence points, top pan and analytical balances<br>• magnetic stirrers and heaters, and water baths |
| **Checking useability of solutions** | Checking useability of solutions may include:<br>• examining stained samples for correct staining reactions<br>• performing pH checks<br>• confirming enzyme activity<br>• checking red cell suspensions for haemolysis<br>• ferric chloride for phenolic solutions<br>• isotonicity for saline |
| **Hazards** | Hazards may include:<br>• chemicals, such as strong acids and bases, and stains |

| RANGE STATEMENT | |
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| | • sharps and broken glassware<br>• burners, hot plates, ovens and furnaces |
| **Safe work practices** | Safe work practices may include:<br>• use of MSDS<br>• use of personal protective equipment, such as gloves, safety glasses, goggles, faceguards, coveralls and gowns<br>• use of biohazard containers, laminar flow cabinets and fume hoods<br>• correct labelling of reagents and hazardous materials<br>• handling and storing hazardous materials and equipment in accordance with labels, MSDS, manufacturer's instructions, and enterprise procedures and regulations<br>• regular cleaning and/or decontaminating of equipment and work areas |
| **Occupational health and safety (OHS) and environmental management requirements** | OHS and environmental management requirements<br>• 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<br>• all operations assume the potentially hazardous nature of samples and require standard precautions to be applied<br>• 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)

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| **Unit sector** | Testing |

# Competency field

| Competency field | |
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# Co-requisite units

| Co-requisite units | | |
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