



Australian Government

MSS025012 Perform environmental microbiological tests

Release: 2

MSS025012 Perform environmental microbiological tests

Modification History

Release 1. Supersedes and is equivalent to MSS025012A Perform environmental microbiological tests.

Release 2. Prerequisite code updated. Equivalent outcome.

Application

This unit of competency covers the ability to receive and prepare samples, and identify and quantitate examples of microorganisms of environmental significance. Personnel will also be able to apply an understanding of the role of microorganisms in bioremediation, agriculture and industrial processes.

This unit of competency is applicable to environmental technicians working in a range of industry sectors, such as environmental monitoring, sampling and field testing (e.g. air, water, groundwater and soil); natural resource management; occupational hygiene monitoring (e.g. air); groundwater and clean water (e.g. catchments, supply and environmental flows); water treatment, storm and wastewater management; and site remediation or rehabilitation.

While no specific licensing or certification requirements apply to this unit at the time of publication, environmental monitoring and management activities are governed by relevant legislation, regulations and/or external accreditation requirements. Local requirements should be checked.

Pre-requisite Unit

MSS024022 Perform environmental biological techniques

Competency Field

Sampling and testing

Unit Sector

Environmental

Elements and Performance Criteria

Elements describe the essential outcomes.

Performance criteria describe the performance needed to demonstrate achievement of the element.

- | | |
|------------------|--|
| 1 Receive | 1.1 Check samples and accompanying documentation in |
|------------------|--|

	microbiological samples		accordance with workplace procedures.
		1.2	Log samples and record sufficient details to enable accurate tracking and chain of custody.
		1.3	Distribute samples for local testing or dispatch samples to other testing facilities, as necessary.
		1.4	Store samples appropriately where testing or transport is to be delayed.
2	Prepare for safe microbiological work and aseptic applications	2.1	Select work area and equipment required for the safe handling of materials that may contain microorganisms of specified risk groups.
		2.2	Wear protective clothing, replacing it when contamination is suspected.
		2.3	Apply correct disinfection procedures to work areas before and after use.
		2.4	Locate relevant emergency equipment for timely response to microbiological accidents.
		2.5	Apply standard precautions when handling biological materials.
		2.6	Minimise the production and release of aerosols, using biological safety cabinets, where necessary.
		2.7	Clean up spills, and report all spills and suspected incidents to supervisor.
		2.8	Wash hands before and after laboratory work and when contamination is suspected.
		2.9	Ensure the safe collection and disposal of biohazardous materials and other laboratory wastes in accordance with workplace procedures.
3	Process samples for direct examination	3.1	Prepare thin smears of samples for subsequent staining to enable microscopic identification of cells.
		3.2	Prepare liquid films of specimens for direct observation of cell structure.

		3.3	Prepare samples to concentrate material for subsequent staining or microscopy.
4	Prepare pure cultures for microbiological work and aseptic applications	4.1	Select culture media to maximise growth of microorganisms and cells.
		4.2	Inoculate media aseptically, applying techniques suitable for purpose of culture.
		4.3	Incubate inoculated media in conditions to optimise growth of organisms and cells.
		4.4	Subculture on suitable media to optimise production of pure cultures.
5	Perform environmental microbiological analyses	5.1	Identify major microorganisms and groups of microorganisms in air, water and soil samples.
		5.2	Count cells in undiluted samples to indicate the dilution necessary to reliably count organisms in culture.
		5.3	Prepare serial dilutions of samples aseptically for culture and colony counting.
		5.4	Count colonies for calculating number of viable organisms per unit volume.
		5.5	Count microorganisms in samples and cultures using spectrometric and electronic methodologies, where relevant.
		5.6	Estimate and document uncertainty of measurement in accordance with workplace procedures, where relevant.
		5.7	Use rapid detection techniques to monitor the presence of microorganisms in water.
		5.8	Use indicator organisms to estimate the likely presence of other pathogenic species.
6	Examine test data for legislative	6.1	Confirm data are the result of valid measurements.
		6.2	Report details of sampling/testing procedures and quality assurance in accordance with legislative

compliance	requirements.
	6.3 Report data in the required format with the appropriate accuracy, precision, statistic type and units.
	6.4 Compare data with specified assessment criteria.
	6.5 Comment on any significant data trends and identify the possible causes or implications.
	6.6 Identify atypical or out-of-range results and the risk and/or instances of potential/actual non-compliance.
	6.7 Confirm all unexpected findings with supervisor.
7 Maintain records	7.1 Enter approved data and results into workplace information management system.
	7.2 Maintain instrument logs as required by accreditation checklists.
	7.3 Maintain security and confidentiality of all client information, data, test results and records.

Foundation Skills

This section describes those required skills (language, literacy and numeracy) that are essential to performance.

Foundation skills essential to performance are explicit in the performance criteria of this unit of competency.

Range of Conditions

This field allows for different work environments and conditions that may affect performance. Essential operating conditions that may be present (depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts) are included.

Legislation, standards, codes, procedures and/or workplace requirements include the latest version of

- federal legislation such as the Environment Protection and Biodiversity Conservation Act
- state/territory government legislation and regulations and local government by-laws, policies, and plans dealing with land use, acquisition, planning and protection; environmental protection; nature conservation; wildlife/plant protection; prevention of

one or more of:

- cruelty to animals and quarantine
- legislation, standards and codes of practice for work health and safety (WHS)
- adopted national exposure standards for atmospheric contaminants in the occupational environment (NOHSC:1003)
- Australian and international standards covering safety in laboratories (AS/NZS 2243.3:2010 Safety in laboratories - Microbiological safety and containment); water microbiology (AS/NZS 4276 Water microbiology series); examination of waters for *Legionellae* (AS/NZS 3896:2008 Waters - Examination for Legionella spp. including Legionella pneumophila); selection of containers and preservation of water samples for microbiological analysis (AS 2031-2012 Water quality - Sampling for microbiological analysis); and air-handling and water systems of buildings - microbial control (AS/NZS 3666 Air-handling and water systems of buildings series)
- international guidelines and methods, such as Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand 2000, Australian guidelines for water quality monitoring and reporting, National Water Quality Management Strategy No. 7, ANZECC & ARMCANZ, Canberra
- American Public Health Association (APHA) Handbook - Water and wastewater analysis
- registration/licensing and/or accreditation requirements
- workplace documents, such as standard operating procedures (SOPs); work schedules; quality management procedures; data quality procedures; sampling/monitoring procedures; validated/authorised test procedures; safety data sheets (SDS) and safety procedures; equipment manuals; recording and reporting procedures; cleaning, hygiene, personal hygiene requirements; waste minimisation, containment, processing and safe disposal procedures.

Environmental microbiological tests include one or more of:

- identification of major groups of environmentally significant organisms, such as:
 - bacteria, Cyanobacteria, Corynebacteria, *Legionella pneumophila*, *Lactobacillus*, *Rhizobia*, hydrocarbon utilising bacteria, and sulfite reducing bacteria
 - Total Coliforms, Faecal Coliforms, *Escherichia coli*, *Enterococci* and Faecal *Streptococci*
 - Archaea
 - *Aspergillus*
 - micro-algae, blue-green algae

- anaerobic protozoa
- indicator microorganisms and their role in predicting likely infectious agents
- enumeration of organisms, and use of counting chambers
- use of selective and enriched media and their role in identification and enumeration of microorganisms, such as:
 - MacConkey's agar (Coliforms)
 - BG11 (Cyanobacteria)
 - yeast mannitol agar (*Rhizobium*)
 - lactose broth
 - ammonium salts
 - nutrient agars
 - tryptic soy agar
 - biochemical tests, such as IMViC (indole, methyl red, Voges-Proskauer and citrate)
 - use of antibiotics, such as cycloheximide (detection of bacteria in presence of yeasts and mould)
 - micro-toxicity testing
 - microbial activity in soils.

Equipment, materials and systems include one or more of:

- protective and physical containment facilities and equipment for safe handling of microorganisms, including personal protective equipment (PPE), such as gloves, gowns, masks and safety glasses, and gloves for working with extremes of heat and cold
- carbon dioxide cabinets and incubators
- transfer equipment, such as inoculating loops, pipettes (quantitative and qualitative), flasks, tubes and spatulas
- liquid nitrogen containers for cell storage
- filtration membranes
- microscopes with bright field and other relevant illumination systems and stereomicroscopes
- counting chambers for micro-enumeration
- colony counting devices
- Bunsen burners and bench incinerators
- incubators and water baths
- anaerobic jars, fermentation chambers, continuous culture systems and other devices for controlling growth environments of microorganisms
- laboratory information management systems (LIMS), databases, record and filing systems
- stains, media, reagents and biological materials necessary for

	- laboratory testing - laboratory glassware and measuring equipment - disinfecting and sterilising solutions and equipment, such as ultraviolet (UV) lamps - materials suitable for the safe containment, collection, processing and disposal of biological and non-biological wastes - autoclaves.
Legislative compliance includes:	- comparison and interpretation of data in comparison with assessment criteria, limits and other regulatory requirements, such as: - exposure standards for atmospheric contaminants in the occupational environment - guidelines for drinking water - allowable pollution index for public recreation areas - discharge of sewage and allowable contamination levels - drawing conclusions about air quality, water quality, and the condition of ecosystems
Use of microorganisms in bioremediation, agriculture and industrial processes includes one or more of:	- treatment of wastewater (especially in sewage) - sulphite reducing bacteria - remediation of oil spills using microorganisms, such as HCB, pseudomonas - production of eco-friendly fuels, such as ethanol
WHS and environmental management requirements include:	- compliance with relevant federal/state/territory WHS legislation at all times - assuming that samples are potentially hazardous and applying standard precautions - accessing and applying current industry understanding of infection control issued by the National Health and Medical Research Council (NHMRC) and state/territory Departments of Health, where relevant.

Unit Mapping Information

Release 1. Supersedes and is equivalent to MSS025012A Perform environmental microbiological tests

Links

The MSS Sustainability Companion Volume implementation Guides are available from VETNet: -

<https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=5b04f318-804f-4dc0-9463-c3fb9a3fe998>

Assessment Requirements for MSS025012 Perform environmental microbiological tests

Modification History

Release 1. Supersedes and is equivalent to MSS025012A Perform environmental microbiological tests.

Release 2. Prerequisite code updated. Equivalent outcome.

Performance Evidence

Evidence of competence in this unit must satisfy all of the requirements of the elements and performance criteria, and include demonstration of:

- performing each of the following environmental microbiological techniques/tests on at least two (2) occasions:
 - preparing specimen samples, such as thin smears, liquid films and concentrates for direct examination
 - using standard media selection, inoculation, incubation and subculturing techniques to grow cultures of environmentally significant microorganisms
 - conducting microscopic examination of samples to identify and count cells and colonies
 - conducting microbiological analyses (e.g. spectrometric, electronic, rapid detection, indicator organisms) to identify and/or enumerate environmentally significant microorganisms
- interpreting instructions, sampling/test methods, manuals, guidelines and applying workplace procedures
- logging, tracking and reporting microbiological samples from collection/receipt through to completion of a procedure
- setting up, cleaning and optimising the performance of light microscopes
- identifying artefacts or image aberrations attributable to misalignment or obstruction of light paths or condensers used in bright field, dark ground, phase and fluorescent microscopy, or with other steps in microscopic examinations
- identifying Gram reactions accurately
- accurately describing bacterial colony forms on common media used in bacteriological investigations
- performing reliable colony/cell/microorganism counts, estimations and calculations
- checking the quality and validity of data and recording/storing test results in accordance with workplace procedures
- comparing microbiological data with relevant assessment criteria to identify significant data trends and atypical results, possible causes or implications and risk/instances of non-compliance
- preparing documentation that is concise, accurate and meets workplace and/or legislative requirements

- using personal protective clothing, safety equipment and procedures to prevent contaminating oneself, other people, work area, equipment, samples, or media/reagents during manipulations involving transfer of cultures
- demonstrating safe sterilisation, disinfection, cleaning, spillage, decontamination and waste disposal techniques
- seeking advice when issues/problems are beyond scope of competence/responsibility
- preparing data and documentation that is accurate, concise and in accordance with workplace requirements
- working safely and reporting all incidents or accidents.

Knowledge Evidence

Must provide evidence that demonstrates knowledge of:

- microbiological terminology relevant to job role covering bacteriology, parasitology and mycology
- cell biology and chemistry related to laboratory phenomena, such as growth and isolation of organisms for identification
- microbial genetics
- microbial diversity
- microorganisms of importance in assessment of the natural environment
- diseases associated with air, water and soil-borne microorganisms
- transmission and infection mechanisms and vectors
- population growth curves for microorganisms
- anti-microbial agents and their suitability/efficacy in a variety of situations
- relevant disinfection and sterilisation procedures
- rationale for sample dilution when preparing materials for enumerating organisms and other pure culture work (e.g. most probable number (MPN) technique)
- need for accurate identification of sample source (e.g. field location)
- sampling procedures for the microbiological testing of drinking water which should conform to the guidelines published by the National Health and Medical Research Council (NHMRC), and the Australian Water Resources Council
- testing procedures for the microbiological content of air, water and soil which should be guided by advice of relevant national and state/territory environment protection agencies
- identification of indicator microorganisms to assist in determining the cause, time or nature of pollution
- use of microorganisms in wastewater treatment
- use of microorganisms in toxic spill recovery
- use of microorganisms in site remediation
- collection and disposal of waste, waste minimisation principles
- relevant hazards, controls and safety procedures – especially those associated with handling microorganisms.

Assessment Conditions

- Judgement of competence must be based on holistic assessment of the evidence. Assessment methods must confirm consistency of performance over time, rather than a single assessment event.
- This unit of competency is to be assessed in the workplace, or a simulated workplace environment. A simulated workplace environment must reflect realistic operational workplace conditions that cover all aspects of workplace performance, including the environment, task skills, task management skills, contingency management skills and job role environment skills.
- Foundation skills are integral to competent performance of the unit and should not be assessed separately.
- Assessment processes and techniques must be appropriate to the language, literacy and numeracy requirements of the work being performed and the needs of the candidate.
- Knowledge evidence may be collected concurrently with performance evidence or through an independent process such as workbooks, written assessments or interviews (provided a record is kept in each case).
- Holistic assessment methods include:
 - inspection of media/samples/cultures and review of data, results and records prepared by the candidate
 - feedback from supervisors that the candidate can safely perform the environmental microbiological techniques/tests listed above and provide reliable results within the agreed timeframe
 - oral and/or written questions to assess the candidate's knowledge of safe handling, culturing, testing and examination of environmentally significant microorganisms, analysis of results and record keeping
 - integrated assessment with a case study focus, such as the isolation and identification of bacterial species in a specimen containing two or more species, by relating sample, cultural, morphological and biochemical data, and such from other relevant tests and procedures.
- Access is required to all instruments, equipment, materials, workplace documentation, procedures, and specifications associated with this unit including, but not limited to:
 - a standard microbiology laboratory with relevant equipment, test instruments, samples and reagents
 - workplace procedures, sampling/test methods, equipment manuals, safety procedures, safety equipment
 - under duty of care requirements, off-the-job training providers will only use biological samples and organisms of a risk category that is compatible with their laboratory as defined in *AS/NZS 2243.3 Safety in laboratories - Microbiological aspects and containment facilities*.
- Assessors must satisfy the assessor competency requirements that are in place at the time of the assessment as set by the VET regulator.
- The assessor must demonstrate both technical competency and currency.
- Technical competence can be demonstrated through:
 - relevant VET or other qualification/Statement of Attainment AND/OR

- relevant workplace experience
- Currency can be demonstrated through:
 - performing the competency being assessed as part of current employment OR
 - having consulted with an organisation providing environmental monitoring, management or technology related services about performing the competency being assessed within the last twelve months.

Links

The MSS Sustainability Companion Volume implementation Guides are available from VETNet: -

<https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=5b04f318-804f-4dc0-9463-c3fb9a3fe998>