



**Australian Government**

**Department of Education, Employment and Workplace Relations**

# **MSATMVER501A Verify a complex measuring instrument**

**Revision Number: 1**

## MSATMVER501A Verify a complex measuring instrument

### Modification History

Not applicable.

### Unit Descriptor

|                        |                                                                                                                                                                                                                                                                                                                                                                                                         |
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| <b>Unit descriptor</b> | This unit of competency covers the ability to apply National Test Procedures to determine whether a complex measuring instrument is suitable for trade use. It involves the ability to install/repair instruments, perform lengthy calculations to assess instrument performance and conduct tests that may require coordination of a range of resources over long durations in hazardous environments. |
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### Application of the Unit

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| <b>Application of the unit</b> | <p>This unit of competency is applicable to verifiers who operate under a licence to test and mark a specific class of complex measuring instruments. Complex measuring instruments are used in a wide range of heavy industries. For example, automatic rail weighbridges, belt weighers, totalising hoppers and liquid petroleum gas (LPG) flow meters are used throughout the mining, road/rail freight and petroleum/gas industry sectors.</p> <p>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'.</p> |
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### Licensing/Regulatory Information

Not applicable.

## Pre-Requisites

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| <b>Prerequisite units</b> |  |  |
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## Employability Skills Information

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| <b>Employability skills</b> | This unit contains employability skills. |
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## 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. |
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## Elements and Performance Criteria

| ELEMENT                                              | PERFORMANCE CRITERIA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
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| 1. Install and repair a complex measuring instrument | 1.1. Plan installation/repair strategy to ensure minimal disruption to the public and/or trader<br>1.2. Access and correctly interpret information for installing or repairing instrument<br>1.3. Select required components, tools and equipment in accordance with manufacturer/component supplier specifications<br>1.4. Perform installation or repair in accordance with legislation, industry codes of practice and organisational guidelines<br>1.5. Avoid instrument damage during installation or repair<br>1.6. Perform a pre-verification test to validate instrument performance                            |
| 2. Prepare for verification                          | 2.1. Identify and evaluate the type of instrument to be verified<br>2.2. Access and correctly interpret documentation required for the verification<br>2.3. Identify and access test equipment, products and consumables required for the verification<br>2.4. Ensure specified test equipment is fit for purpose in accordance with applicable legislation and organisational procedures<br>2.5. Store and transport test equipment in accordance with organisational procedures and industry best practice<br>2.6. Develop a verification strategy to maximise resources and minimise time required for complex tests |
| 3. Liaise with the trader to schedule complex tests  | 3.1. Discuss testing arrangements with site controller where applicable<br>3.2. Identify relevant local workplace, health and safety issues and implement appropriate control strategies<br>3.3. Discuss the verification strategy with the trader to minimise its impact on the trader's normal operations<br>3.4. Arrange site clearances and suitable scheduling for tests<br>3.5. Negotiate access to trader's equipment, materials and support personnel required for testing to be available on site                                                                                                              |

| ELEMENT                                              | PERFORMANCE CRITERIA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
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|                                                      | 3.6. Arrange for any equipment to be provided by the trader, if required, by the National Test Procedure                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 4. Initiate verification                             | 4.1. Identify the site controller and explain/review the purpose of the verification<br>4.2. Review verification strategy to ensure there is minimal disruption to the public and/or trader<br>4.3. Communicate verification strategy to personnel supporting the verification<br>4.4. Identify locations for product return or disposal, if applicable<br>4.5. Evaluate the impacts of the operating environment on the instrument performance or test results and implement corrective actions as necessary<br>4.6. Identify operational factors impacting on instrument performance or test result and implement corrective actions as necessary |
| 5. Evaluate complex measuring instrument performance | 5.1. Identify the maximum permissible errors for the instrument from the legislative requirements<br>5.2. Manage and review resources to maintain verification timelines<br>5.3. Provide effective communication to ensure relevant personnel are informed of variations to the verification strategy and verification progress<br>5.4. Check instrument for compliance with the appropriate Certificates of Approval<br>5.5. Test the instrument in accordance with relevant National Test Procedure and appropriate National Measurement Institute Policy                                                                                         |
| 6. Analyse verification results                      | 6.1. Perform specified calculations to determine a performance result for the instrument with appropriate accuracy, precision and significant figures<br>6.2. Use graphical and statistical analysis to determine unknowns as necessary<br>6.3. Ensure calculations are consistent with estimations and reasonable expectations<br>6.4. Evaluate results against prescribed performance criteria and determine if the instrument is suitable for trade use in accordance with legislative requirements                                                                                                                                              |
| 7. Model and encourage compliance with               | 7.1. Apply organisation's procedures and practices to meet licensing requirements                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

| ELEMENT                        | PERFORMANCE CRITERIA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
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| statutory requirements         | <p>7.2. Clarify any uncertainty about licensing requirements with licensing authority as they arise</p> <p>7.3. Review work and seek feedback from others to confirm continuing compliance with licensing requirements</p> <p>7.4. Identify implications of non-compliance with licensing requirements</p> <p>7.5. Raise inadequacies in organisation's procedures and practices which may contribute to non-compliance with licensing requirements</p> <p>7.6. Identify and communicate inadequacies with trader's procedures and practices which may contribute to non-compliance with national measurement legislation</p> |
| 8. Report verification results | <p>8.1. Display the verification result on the instrument in accordance with legislative requirements</p> <p>8.2. Use test reports to present verification results in the required format</p> <p>8.3. Complete verification documentation in accordance with legislative requirements and organisational procedures</p> <p>8.4. Communicate results within the specified time and in accordance with organisational guidelines</p>                                                                                                                                                                                            |
| 9. Maintain statutory records  | <p>9.1. Keep accurate and complete records in accordance with licensing requirements</p> <p>9.2. Ensure authorisation, training and relevant licences are current in accordance with organisational and licensing requirements</p> <p>9.3. Inform the licensing administering authority of changes to personal information as required by statute</p>                                                                                                                                                                                                                                                                         |

## Required Skills and Knowledge

### REQUIRED SKILLS AND KNOWLEDGE

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

#### Required skills

- diagnosing faults in complex measuring instruments
- installing and repairing measuring instruments with a complex design
- installing/upgrading software
- accessing, interpreting and applying a range of documents for the verification of complex measuring instruments including:
  - national measurement legislation
  - intermediate National Test Procedures
  - Certificates of Approval
  - National Measurement Institute inspection policy
  - Australian Standards
  - industry codes of practice
  - correction tables for volume, density and pressure for a range of liquids
  - national and international design rules
  - pattern approval documents
- performing verification tests over extended durations up to five days in non-routine and hazardous environments
- accessing and interpreting Certificates of Verification for a wide range of reference standards
- using advanced communication and negotiation skills to:
  - explain purpose of the verification
  - inform traders of non-compliances and consequences of failing to rectify
  - access external equipment and resources to complete the verification
  - explain verification procedures and outcomes to traders and managers
- accessing, transporting, setting up, validating, using and maintaining a broad range of test equipment and reference standards
- organising large equipment to be dispatched ahead of verification visit
- identifying and evaluating environmental factors that may impact on performance of complex measuring instruments
- conducting lengthy tests and recording results with close attention to detail and accuracy
- performing calculations involving:
  - fractions, decimals, ratios, proportions and percentages
  - evaluation of formulae containing powers, exponents and logarithms functions
  - use of scientific notation, correct units and correct number of significant figures
  - calculation of uncertainties

## REQUIRED SKILLS AND KNOWLEDGE

- preparation and interpretation of linear, semi-log and log-log graphs
- interpretation of statistical quantities, such as mean, median, mode, range, variance and standard deviation
- determination of regression line equations and correlation coefficients
- preparation and interpretation of more complex control charts and frequency distribution plots
- analysing performance results over a broad range of operating conditions
- planning complex tasks
- developing/implementing an efficient verification strategy that minimises disruption to traders, the public, technicians, employees, colleagues and suppliers
- demonstrating professionalism and maintaining the rights of the trader at all times
- solving unexpected problems and non-routine issues
- working safely which may include applying basic first aid, confined space entry, working with hazardous materials, working safely in hazardous environments, working with heavy machinery, Australian Institute of Petroleum (AIP) cold work clearance permit, safety induction, working at heights and biosecurity issues

## Required knowledge

- the design, major components and functions of relevant complex measuring instruments
- licensing requirements for a verifier including:
  - quality management system
  - licence conditions
  - maintenance of statutory records
- general chemical and physical principles and concepts including:
  - physical states (solid, liquid gas)
  - weight, mass, gravity and density
  - pressure, pressure differential, backpressure and head pressure
  - fluid flow
  - flashpoint, boiling point and ice point
  - viscosity
  - temperature effects and coefficients of expansion
- knowledge of the operating procedures across a range of environments including laboratories, retail, commercial, office, manufacturing, industrial, mining, construction, medical, chemical and petroleum
- knowledge of metrological terms and terminology specific to complex measuring instruments such as:
  - maximum permissible errors, maximum permissible difference and maximum permissible variation
  - traceability
  - repeatability

**REQUIRED SKILLS AND KNOWLEDGE**

- uncertainty, error of measurement and error of indication
- meter creep
- hose dilation
- temperature correction
- linearisation
- gas elimination
- national measurement legislation applicable to complex measuring instruments
- detailed knowledge of National Test Procedures and operating procedures for equipment and reference standards used in job role including:
  - purpose of test
  - test conditions and possible environmental impacts on performance of the instrument
  - key preparation/measurement steps in test method
  - calculation steps to give results in appropriate units and precision
  - maximum permissible errors for complex measuring instruments under inspection
- procedures for completing verification documentation
- organisational policy and procedures for verifying instruments
- safety principles and procedures relevant to instruments and test environment
- basic first aid and site safety induction if required

## Evidence Guide

| <b>EVIDENCE GUIDE</b>                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
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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. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Overview of assessment</b>                                                                                                                                                                                          | Competency must be demonstrated in the ability to perform consistently at the required standard for one class of complex instrument listed in the Range Statement.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Critical aspects for assessment and evidence required to demonstrate competency in this unit</b>                                                                                                                    | <p>Assessors should ensure that candidates can:</p> <ul style="list-style-type: none"> <li>• identify, access and apply test procedures</li> <li>• identify and use suitable reference standards</li> <li>• install and repair measuring instruments to meet statutory requirements</li> <li>• evaluate and adjust the impact of the operating environment on the performance of the instrument</li> <li>• analyse test results to determine the instrument's suitability for verification (trade use)</li> <li>• maintain the security and confidentiality of data in accordance with organisational and regulatory requirements</li> <li>• report results in the required formats and expected timeframe.</li> </ul> |
| <b>Context of and specific resources for assessment</b>                                                                                                                                                                | <p>This unit of competency is to be assessed in the workplace or simulated workplace environment.</p> <p>This unit of competency may be assessed with:</p> <ul style="list-style-type: none"> <li>• MSATMREF301A Use and maintain reference standards.</li> </ul> <p>Resources may include:</p> <ul style="list-style-type: none"> <li>• access to a complex measuring instrument, test equipment and reference standards</li> <li>• computer and relevant software and/or organisation information management system</li> <li>• Certificates of Approval for the instrument</li> <li>• relevant legislative and organisational procedures.</li> </ul>                                                                 |
| <b>Method of assessment</b>                                                                                                                                                                                            | <p>The following assessment methods are suggested:</p> <ul style="list-style-type: none"> <li>• questions to assess understanding of relevant complex test procedures and remedial actions</li> <li>• review of verification reports prepared by the</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

**EVIDENCE GUIDE**

|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
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|                                    | <p>candidate</p> <ul style="list-style-type: none"> <li>• feedback from supervisors and peers regarding the candidate's ability to verify the performance of instruments in accordance with legislative and organisational procedures.</li> </ul> <p>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.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>This competency in practice</b> | <p>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.</p> <p>A licensed verifier has been engaged by a large coal mine to verify a new belt weigher installation for trade use. In preparation, the verifier visits the site and considers how to complete the verification. He/she visually inspects the belt weigher and is satisfied that it complies with the Certificate of Approval. However, he/she determines that the 30 tonne hopper weigher which has been installed as a control instrument for the sole purpose of testing the belt weigher cannot be tested with 1 tonne masses due to access restrictions. The verifier discusses these issues with the local trade measurement inspector who offers two solutions. The inspector suggests testing the restricted access hopper weigher with 20 kg masses using the substitution method to reduce the number of test masses required or negotiating with the coal washing facility next door to use their 60 tonne weighbridge as the control instrument. The verifier considers the options and decides in the interests of workplace health and safety that the best option is to use the weighbridge next door. After considerable negotiation with the weighbridge owner, arrangements are made to test the weighbridge and make it available for the belt weigher test on Monday and Tuesday of the following week. The trader organises to have 5000 tonnes of coal, a front end loader and three transfer vehicles available for the test. The verifier arranges with another organisation to have 20 tonnes of certified test masses delivered to the coal wash facility on Monday so he/she can test the weighbridge. On</p> |

**EVIDENCE GUIDE**

Monday, the verifier tests the weighbridge in accordance with the national uniform test procedures and confirms that it is suitable for use as the control instrument. Testing of the belt weigher commences in accordance with the national uniform test procedure and progresses well on the Monday. On Tuesday, the verifier arrives on site to find the tail drum on the conveyor belt has seized making it impossible to continue testing. As these repairs will take two days to repair, the test is terminated and rescheduled with all parties to be in two weeks. Two weeks later the weighbridge is again retested and found to be suitable as a control instrument. The belt weigher is tested fully in accordance with the National Test Procedures and found to be correct. The verifier marks the belt weigher with a verification mark, completes all the paper work including test reports and submits them to national Trade Measurement with 14 days.

## 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.

#### Prescribed performance criteria for instruments

Prescribed performance criteria for instruments may include:

- design is in accordance with the appropriate Certificates of Approval
- performance meets the criteria described in the Certificates of Approval, National Test Procedure and legislation

#### Appropriate documentation

Where reference is made to documentation, it is expected the latest version will be used.

Appropriate documentation may include:

- reference standards
- Certificates of Verification
- Certificates of Approval for complex instruments
- test procedures for verifying complex instruments
- organisational test reports
- organisational procedures e.g. company quality assurance manual
- National Measurement Act
- occupational health and safety (OHS) regulations, guidelines and procedures and material safety data sheets (MSDS)
- equipment manuals and warranty, supplier catalogues and handbooks

#### Certificates of Approval

Certificates of Approval may include:

- any Certificate issued by the Chief Metrologist under Regulation 60 of the National Measurement Regulations approving the pattern of a complex instrument as being suitable for trade

#### Test equipment

Test equipment may include:

| <b>RANGE STATEMENT</b>                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|---------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                         | <ul style="list-style-type: none"> <li>reference standards of measurement</li> <li>equipment other than reference standards of measurement such as weighing instruments, pumping units, control instruments, two way communication, hoses, fittings, rail wagons, trains and tankers</li> <li>LPG cylinders</li> </ul>                                                                                                                                                                                                                                                 |
| <b>Legislation</b>                                      | <p>Legislation may include:</p> <ul style="list-style-type: none"> <li>national measurement legislation</li> <li>applicable Commonwealth, state and territory OHS legislation</li> </ul>                                                                                                                                                                                                                                                                                                                                                                               |
| <b>National Measurement Institute policy</b>            | <p>National Measurement Institute policy may include:</p> <ul style="list-style-type: none"> <li>accepted test procedure variations</li> <li>bulletin</li> <li>instruction</li> <li>determination</li> </ul>                                                                                                                                                                                                                                                                                                                                                           |
| <b>National Test Procedures for complex instruments</b> | <p>National Test Procedures for complex instruments may include</p> <ul style="list-style-type: none"> <li>non-automatic weighing machines &gt;3 tonne</li> <li>LPG dispensers</li> <li>LPG bulk flowmetering systems</li> <li>flowmetering systems tested using master meter or gravimetric methods</li> <li>automatic rail weighbridges</li> <li>continuous totalising automatic weighing instruments (belt weighers)</li> <li>totalising hoppers weighing instruments</li> <li>any other test procedure prescribed by the National Measurement Institute</li> </ul> |
| <b>OHS and environmental management requirements</b>    | <p>OHS and environmental management requirements refer to:</p> <ul style="list-style-type: none"> <li>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</li> <li>all operations assume the potentially hazardous nature of samples and require</li> </ul>                                                                                                                                          |

| <b>RANGE STATEMENT</b>                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
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|                                        | <p>standard precautions to be applied</p> <ul style="list-style-type: none"> <li>• where relevant, 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</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Operating environmental impacts</b> | <p>Operating environmental impacts may include:</p> <ul style="list-style-type: none"> <li>• vibration</li> <li>• wind</li> <li>• heat</li> <li>• dust</li> <li>• electromagnetic interference</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Specified calculations</b>          | <p>Specified calculations may include:</p> <ul style="list-style-type: none"> <li>• calculations involving fractions, decimals, ratios, proportions and percentages</li> <li>• evaluation of formulae containing powers, exponents and logarithms functions</li> <li>• use of scientific notation, correct units and correct number of significant figures</li> <li>• calculation of uncertainties</li> <li>• preparation and interpretation of linear, semi-log and log-log graphs</li> <li>• calculation and interpretation of statistical quantities, such as mean, median, mode, range, variance and standard deviation</li> <li>• determination of regression line equations and correlation coefficients</li> <li>• preparation and interpretation of more complex control charts and frequency distribution plots</li> </ul> |
| <b>Records</b>                         | <p>Records may include:</p> <ul style="list-style-type: none"> <li>• test reports</li> <li>• safety procedures</li> <li>• a history of equipment calibration and test results</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Complex instruments</b>             | <p>Verifiers may be licensed to test and mark specific classes of instruments from the following list.</p> <p>Complex instruments may include:</p> <ul style="list-style-type: none"> <li>• non-automatic weighing machines &gt;3 tonne</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

**RANGE STATEMENT**

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|  | <ul style="list-style-type: none"> <li>• LPG dispensers</li> <li>• LPG bulk flowmetering systems</li> <li>• flowmetering systems tested using master meter or gravimetric methods</li> <li>• automatic rail weighbridges</li> <li>• continuous totalising automatic weighing instruments (belt weighers)</li> <li>• totalising hoppers weighing instruments</li> <li>• any other complex measuring instrument prescribed by the National Measurement Institute</li> </ul> |
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**Unit Sector(s)**

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| <b>Unit sector</b> | Trade Measurement |
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**Competency field**

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| <b>Competency field</b> |  |
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**Co-requisite units**

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| <b>Co-requisite units</b> |  |  |
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