



Australian Government

MSL925002 Analyse measurements and estimate uncertainties

Release: 1

MSL925002 Analyse measurements and estimate uncertainties

Modification History

Release 1. Supersedes and is equivalent to MSL925002A Analyse measurements and estimate uncertainties

Application

This unit of competency covers the ability to use statistical analysis to estimate and report measurement uncertainty in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (or its replacement Standard). Personnel are required to review their estimates of measurement uncertainty to assist with making decisions on the fitness for purpose of the measurements.

This unit of competency is applicable to laboratory personnel who work in calibration and testing facilities, process and interpret data and are required to determine uncertainties using standard methods. The rigour required in estimating uncertainty will depend on the required accuracy of the particular calibration, test or measurement.

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

Pre-requisite Unit

MSL924001 Process and interpret data

Competency Field

Data

Unit Sector

Elements and Performance Criteria

Elements describe the essential outcomes.

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

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|---|--|-----|---|
| 1 | Identify the measured quantity and the uncertainty components | 1.1 | Specify an equation for the measurement |
| | | 1.2 | List uncertainty components that are associated with each input in the equation |

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|---|---|-----|---|
| 2 | Determine the size of each uncertainty component | 2.1 | Calculate the standard deviations and standard deviation of the mean from the measurement results |
| | | 2.2 | Use calibration reports, manufacturer's specifications, quality control and validation data, and experimental data to collect other available information on the uncertainty components |
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| 3 | Reduce each uncertainty component to a standard uncertainty | 3.1 | Allocate an appropriate distribution for each uncertainty component |
| | | 3.2 | Calculate the standard uncertainties |
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| 4 | Calculate an expanded uncertainty to the required confidence level | 4.1 | Calculate the sensitivity coefficient for each uncertainty component |
| | | 4.2 | Calculate a combined standard uncertainty |
| | | 4.3 | Determine an appropriate coverage factor based on the degrees of freedom associated with each uncertainty component |
| | | 4.4 | Calculate the expanded uncertainty |
| | | | |
| 5 | Report the expanded uncertainty | 5.1 | Report the result and uncertainty to an appropriate number of significant figures |
| | | 5.2 | Report the confidence level and coverage factor |
| | | 5.3 | Determine the appropriateness of the size of the expanded uncertainty relative to the tolerance or required accuracy of the test |
| | | 5.4 | Determine the fitness for purpose of the expanded uncertainty relative to the use of the measurement result |

Foundation Skills

This section describes those language, literacy, numeracy and employment skills 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.

Standards, codes, procedures and/or workplace requirements

Standards, codes, procedures and/or enterprise requirements include the latest version of one or more of:

- Australian and international standards and guides, such as:
 - competency requirements for testing and calibration laboratories, quality management and measurement management
 - ISO 5725 Accuracy (trueness and precision) of measurement methods and results
 - ISO/IEC Guide 98-3:2008 Uncertainty of Measurement - Part 3 Guide to the Expression of Uncertainty in Measurement
 - Eurachem/CITAC Guide CG4 Quantifying uncertainty in analytical measurement, Eurolab technical report and Nordtest
- National Association of Testing Authorities (NATA) accreditation program requirements and NATA technical notes
- national measurement regulations and guidelines
- Australian codes, such as of good manufacturing practice for medicinal products (GMP), and principles of good laboratory practice (GLP)
- workplace documents, such as quality manual, customer quality plan, equipment manuals and warranty, supplier catalogues and handbooks
- validated sampling and test procedures

Data

Data includes:

- worksheets, spreadsheets or databases linked to information management systems
- the results of tests, measurements and analyses
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Records

Records include information associated with one or more of:

- purchase of equipment and materials and service records
- manufacturer datasheets
- calibration reports
- history of calibration and test results

Work health and safety (OHS) and environmental management requirements

WHS and environmental management requirements include:

- complying with WHS and environmental management requirements at all times, which may be imposed through state/territory or federal legislation. These requirements must not be compromised at any time
- applying standard precautions relating to the potentially hazardous nature of samples
- accessing and applying current industry understanding of infection control issued by the National Health and Medical Research Council (NHMRC) and State and Territory Departments of Health, where relevant

Unit Mapping Information

Release 1. Supersedes and is equivalent to MSL925002A Analyse measurements and estimate uncertainties

Links

Companion Volume implementation guides are found in VETNet -

<https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=5c63a03b-4a6b-4ae5-9560-1e3c5f462baa>

Assessment Requirements for MSL925002 Analyse measurements and estimate uncertainties

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Performance Evidence

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

- using scientific notation, correct units and correct number of significant figures
- evaluating formulae containing powers, exponents and logarithms functions
- preparing and interpreting linear graphs
- using statistical analysis to estimate and report measurement uncertainty in accordance with the *ISO Guide to the Expression of Uncertainty in Measurement*
- preparing a fully documented, realistic uncertainty budget that is appropriate for the application
- calculating a combined standard uncertainty using root-sum-of-squares, accounting for correlations where necessary
- gathering information about uncertainty components from calibration reports or reference material report
- calculating sensitivity coefficients either experimentally or by partial differentiation
- calculating expanded uncertainty
- using spreadsheets to calculate uncertainties
- deciding if the uncertainty is suitable for the accuracy required for the test and establishing whether it is fit for purpose using the tolerance to uncertainty ratio (TUR)
- using and interpreting mean, standard deviation, standard deviation of the mean, degrees of freedom, histograms and frequency plots, probability, normal probability plots and control charts
- using the student's t-table to get a coverage factor for a particular level of confidence
- using and interpreting significance tests, such as t-test, f-test and analysis of variance (ANOVA), variances, standard deviation of prediction and linear regression
- using regression methods for calibration, linearity checks and comparing analytical methods
- using and interpreting normal, rectangular, triangular distributions and the factors used to reduce each to a standard uncertainty
- allocating degrees of freedom to each uncertainty component using the Welch-Satterthwaite equation
- reporting results and uncertainties in the required formats.

Knowledge Evidence

Must provide evidence that demonstrates knowledge of:

- the steps in the measurement, test or calibration involved
- the difference between errors, corrections and uncertainties
- uncertainty in the uncertainty estimation process
- uncertainty components that are common to the use of an instrument
- uncertainty components that arise due to the instrument being used under different conditions to those when it was calibrated
- uncertainty components, such as:
 - calibration uncertainty
 - instability or drift in the calibrated instrument
 - repeatability of the results
 - resolution or readability of the instrument
 - environmental influences, such as temperature, air pressure, humidity, vibration, electrical noise and gravity
 - reference material uncertainty
 - factors arising from using an instrument under a different operating environment or procedures (e.g. orientation of a transducer and immersion depth of a temperature probe)
 - reproducibility of quality control data
- procedures for determining the uncertainty components associated with each of the inputs and whether they are significant and for applying appropriate corrections
- manufacturer's specifications (e.g. instrument drift specification and reference materials)
- procedures for determining uncertainty components from quality control data
- the concept of degrees of freedom
- the characteristics of a valid measurement
- reporting requirements, such as the uncertainty in measurement (GUM), National Association of Testing Authorities (NATA) or other applicable reference material
- confidence levels required by the National Measurement Act 1960 (e.g. 95% for most applications, but others may require a higher confidence level).

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).
- This unit of competency may be assessed with:
 - MSL904001 Perform standard calibrations
 - MSL905001 Perform non-standard calibrations
- Holistic assessment methods include:
 - review of data worksheets, calculations, spreadsheets, databases, statistical analysis, graphs and/or tables prepared by the candidate
 - questions to assess understanding of relevant procedures, trends in data and sources of uncertainty
 - review of reports and records prepared by the candidate
 - feedback from supervisors and peers regarding the candidate's ability to estimate uncertainty in accordance with workplace procedures.
- Access is required to all instruments, equipment, materials, workplace documentation, procedures and specifications associated with this unit, including, but not limited to:
 - data sets and records
 - test methods and description of test set-up
 - computer and relevant software or laboratory information system
 - workplace procedures.
- 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 a laboratory about performing the competency being assessed within the last twelve months.

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