Eurachem A FOCUS FOR ANALYTICAL CHEMISTRY IN EUROPE

Reading List for Analytical Scientists

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Introduction and scope

This reading list has been prepared by members of the Eurachem Education and Training Working Group. It is based on bibliographies originally produced by TrainMiC® and LGC (in its role as the UK's National Measurement Laboratory and Designated Institute for chemical and bio-measurement, (www.uknml.com) – but has been substantially updated. The main focus of the references contained in the list is metrology in chemistry, with a particular focus on quality assurance. However, it is anticipated that the references will also be of interest to those working in other disciplines. It is not intended to be a comprehensive list of all publications relating to quality in analytical measurement. The aim is to provide references to a selection of websites, standards, guides and books which will hopefully be of use to all those involved with chemical analysis (and related disciplines), including laboratory staff, students, lecturers and trainers.

Many of the references provided in this list are available to download free of charge, in particular documents published by Eurachem, JCGM, Euramet, Eurolab, ILAC, EA and accreditation bodies.

The aim is to update the bibliography annually. The Working Group welcomes suggestions for additions to the bibliography. Please see the contact form for the working group to send additional references.

Updates or additions are identified by a side bar.

Eurachem provides this list for information and is not responsible for the content or advice given in the resources listed. Any software listed has not been independently validated by Eurachem.

References are current as of 15 May 2025

Introduction to metrology and terminology

Websites and web resources

- CIPM Mutual recognition arrangement (MRA) of national measurement standards and of calibration and measurement certificates issued by national metrology institutes (www.bipm.org/en/cipm-mra/)
- ISO online browsing platform – access ISO standards, terms and definitions (www.iso.org/obp/ui/)
- VIM Definitions with Informative Annotations, JCGM-WG2 (https://jcgm.bipm.org/vim/en/index.html)

Standards

- BIPM, IEC, IFCC, ILAC, ISO, IUPAC, IUPAP, OIML. JCGM 200:2012 (JCGM 200:2008 with minor corrections), International vocabulary of metrology – Basic and general concepts and associated terms (VIM3) (www.bipm.org) (Earlier version printed as ISO Guide 99:2007 (www.iso.org, link to free version https://www.iso.org/resources/publicly-available-resources.html)
- ISO 80000-1:2022. Quantities and units – Part 1: General (www.iso.org)

Guides

- V. Barwick (Ed) Eurachem Guide: Terminology in analytical measurement – Introduction to VIM3 (2nd ed. 2023). ISBN 978-0-948926-40-2 (www.eurachem.org)
- A beginner's guide to measurement, v3, Good practice guide no. 118, NPL, 2010, ISSN: 1368-6550 (https://www.npl.co.uk/gpgs/beginners-guide-to-measurement)
- The International System of Units (SI), 9th Edition, 2019 (v2.01, December 2022) (www.bipm.org)

Books

- Compendium of Chemical Terminology, 2nd ed. (the 'Gold Book'). Compiled by A. D. McNaught and A. Wilkinson. Blackwell Scientific Publications, Oxford (1997). Online version (2019-) created by S. J. Chalk. ISBN 0-9678550-9-8. (https://goldbook.iupac.org/)
- IUPAC Quantities, units and symbols in physical chemistry ('Green Book'), 3rd Edition, 2007, ISBN 978-0-85404-433-7 (https://iupac.org/wp-content/uploads/2019/05/IUPAC-GB3-2012-2ndPrinting-PDFsearchable.pdf)
- Compendium of terminology in analytical chemistry ('Orange Book), 4th edition, D. Brynn Hibbert (Ed), The Royal Society of Chemistry (2023), ISBN (print): 978-1-78262-947-4, https://doi.org/10.1039/9781788012881 (note that the content of the Orange Book is available as a series of IUPAC Recommendations – see Articles and Reports section)

Leaflets

- Eurachem information leaflet
  - You talk, we understand – The way out of the tower of Babel [An introduction to measurement terminology] (2015, updated 2023) (www.eurachem.org)
- AMC Technical Briefs, RSC, (https://www.rsc.org/membership-and-community/connect-with-others/join-scientific-networks/subject-communities/analytical-science-community/amc/technical-briefs/):
  - AMC TB 86-2019 Revision of the International System of Units (Background paper), https://doi.org/10.1039/C9AY90028D
  - AMC TB 76-2016, Chemical metrology, https://doi.org/10.1039/C6AY90155G

Under Sampling tab

- AMC TB 19-2005, Terminology – the key to understanding analytical science. Part 2: Sampling and sample preparation,

Under Metrology tab

- AMC TB 13-2003, Terminology – the key to understanding analytical science. Part 1: Accuracy, precision and uncertainty

Articles and reports

- D. Brynn Hibbert, E-H Korte, U. Örnemark, Metrological and quality concepts in analytical chemistry (IUPAC Recommendations 2021), Pure Appl. Chem., 2021, 93 (9), 997-1048, https://doi.org/10.1515/pac-2019-0819
- H. Goenaga Infante, J. Warren, J. Chalmers, G. Dent, J. L. Todoli, J. Collingwood, N. Telling, M. Resano, A. Limbeck, T. Schoenberger, D. B. Hibbert, A. LeGresley, K. Adams, D. Craston, Glossary of methods and terms used in analytical spectroscopy (IUPAC Recommendations 2019), Pure Appl. Chem., 2021, 93 (6), 647-776, https://doi.org/10.1515/pac-2019-0203
- Z. Chai, A. Chatt, P. Bode, J. Kučera, R. Greenberg, D. B. Hibbert, Vocabulary of radioanalytical methods (IUPAC Recommendations 2020), Pure Appl. Chem., 2021, 93 (1), 69-111, https://doi.org/10.1515/pac-2019-0302
- J. M. Pingarrón, J. Labuda, J. Barek, C. M. A. Brett, M. F. Camões, M. Fojta, D. B. Hibbert, Terminology of electrochemical methods of analysis (IUPAC Recommendations 2019), Pure Appl. Chem., 2020, 92 (4), 641-694, https://doi.org/10.1515/pac-2018-0109
- T. Takeuchi, A. J. McQuillan, A. Shard, A. E. Russell, D. B. Hibbert, Glossary of methods and terms used in surface chemical analysis (IUPAC Recommendations 2020), Pure Appl. Chem., 2020, 92 (11), 1781-1860, https://doi.org/10.1515/pac-2019-0404
- J. Labuda, R. P. Bowater, M. Fojta, G. Gauglitz, Z. Glatz, I. Hapala, J. Havliš, F. Kilar, A. Kilar, L. Malinovská, H. M. M. Sirén, P. Skládal, F. Torta, M. Valachovič, M. Wimmerová, Z. Zdráhal, D. B. Hibbert, Terminology of bioanalytical methods (IUPAC Recommendations 2018), Pure App. Chem., 2018, 90 (7), 1121-1198, https://doi.org/10.1515/pac-2016-1120
- M. F. Camões, G. D. Christian, D. B. Hibbert, Mass and volume in analytical chemistry (IUPAC Technical Report), Pure Appl. Chem., 2018, 90 (3), 563-603, https://doi.org/10.1515/pac-2017-0410
- T. A. Maryutina, E. Y. Savonina, P. S. Fedotov, R. M. Smith, H. Siren, D. B. Hibbert, Terminology of separation methods (IUPAC Recommendations 2017), Pure Appl. Chem., 2018, 90 (1), 181-231, https://doi.org/10.1515/pac-2017-0111
- C. Poole, Z. Mester, M. Miró, S. Pedersen-Bjergaard, J. Pawliszyn, Extraction for analytical scale sample preparation (IUPAC Technical Report), Pure Appl. Chem., 2016, 88 (7), 649-687, https://doi.org/10.1515/pac-2015-0705
- D. B. Hibbert, Vocabulary of concepts and terms in chemometrics (IUPAC Recommendations 2016), Pure Appl. Chem., 2016, 88 (4), 407-443, https://doi.org/10.1515/pac-2015-0605
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Traceability of measurement results

Standards

- ISO 8466-1:2021 Water quality – Calibration and evaluation of analytical methods – Part 1: Linear calibration function (www.iso.org)
- ISO 8466-2:2001 Water quality – Calibration and evaluation of analytical methods and estimation of performance characteristics – Part 2: Calibration strategy for non-linear second-order calibration functions (www.iso.org)
- ISO 11095:1996 Linear calibration using reference materials (www.iso.org)
- ISO 17511:2020 In vitro diagnostic medical devices — Requirements for establishing metrological traceability of values assigned to calibrators, trueness control materials and human samples (www.iso.org)
- ISO 18153:2003. In vitro diagnostic medical devices – Measurement of quantities in biological samples – Metrological traceability of values for catalytic concentration of enzymes assigned calibrators and control materials (www.iso.org)
- ISO/TS 28037:2010. Determination and use of straight-line calibration functions (www.iso.org)

Guides

- S.L.R. Ellison and A. Williams (Eds) Eurachem/CITAC Guide: Metrological traceability in analytical measurement (2nd ed. 2019). ISBN 978-0-948926-34-1 (www.eurachem.org)
- M. Jönsson and B. Magnusson, In-house calibration and control of piston operated pipettes, Nordtest Report 626 (1st ed. 2025) (www.nordtest.info)
- Guidance on the calibration of weighing machines used in testing and calibration laboratories, Lab 14, Edition 7, UKAS, 2022 (www.ukas.com)
- ILAC P10:07/2020, ILAC Policy on metrological traceability of measurement results (www.ilac.org)
- ILAC G24:2022, Guidelines for the determination of recalibration intervals of measuring equipment (www.ilac.org)
- Traceability: Volumetric apparatus, LAB 15 Edition 3, UKAS, 2019 (www.ukas.com)
- Guidelines on the calibration of non-automatic weighing instruments, cg-18 Version 4.0, EURAMET, 11/2015, (www.euramet.org)

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- P. Kościelniak, Calibration in Analytical Science: Methods and Procedures, Wiley – VCH, 2023, ISBN 978-3-527-34846-6
- A. Moutzoglou, A. Kastania and S. Archonakis, Laboratory Management Information Systems – Current Requirements and Future Perspectives, IGI Global, 2014, ISBN 978-1-4666-6320-6
- N. Majcen, P. Taylor, T. Martišius, A. Menditto, M. Patriarca, Practical examples on traceability, measurement uncertainty and validation in chemistry Vol 2, 2011, European Commission, Joint Research Centre (https://bookshop.europa.eu/en/home/)
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- P. De Bièvre, H. Günzler (Eds), Traceability of chemical measurement, Springer-Verlag, Heidelberg Berlin, 2005, ISBN 3642078834

Leaflets

- Eurachem information leaflet
  - Metrological traceability of analytical results (2005, updated 2019) (www.eurachem.org)
- AMC Technical Briefs, RSC, (https://www.rsc.org/membership-and-community/connect-with-others/join-scientific-networks/subject-communities/analytical-science-community/amc/technical-briefs/):
  - AMC TB 99-2020, Units and quantities for analytical chemistry, https://doi.org/10.1039/D0AY90126A

Articles and reports

- F. Raposo, Evaluation of analytical calibration based on least-squares linear regression for instrumental techniques: A tutorial review, TRAC-Trend. Anal. Chem., 2016, 77, 167-185, https://doi.org/10.1016/j.trac.2015.12.006
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- C. D. Ehrlich, S. D. Rasberry, Metrological timelines in traceability, J. Res. Natl. Inst. Stand. Technol., 1998, 103, 93-105 (www.nist.gov)
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Uncertainty of measurement

Standards

- BIPM, IEC, IFCC, ISO, IUPAC, IUPAP, OIML JCGM 100:2008, Evaluation of measurement data – Guide to the expression of uncertainty in measurement (GUM 1995 with minor corrections) (www.bipm.org) (Printed as ISO/IEC Guide 98-3:2008 (www.iso.org, link to free version https://www.iso.org/resources/publicly-available-resources.html)
- JCGM has produced a number of supplements to accompany the GUM, available at www.bipm.org:
  - Evaluation of measurement data – The role of measurement uncertainty in conformity assessment, JCGM 106:2012
  - Evaluation of measurement data – Supplement 2 to the "Guide to the expression of uncertainty in measurement" – Extension to any number of output quantities, JCGM 102:2011
  - Evaluation of measurement data – An introduction to the "Guide to the expression of uncertainty in measurement" and related documents, JCGM GUM 1:2023
  - Evaluation of measurement data – Supplement 1 to the "Guide to the expression of uncertainty in measurement" – Propagation of distributions using a Monte Carlo method, JCGM 101:2008
- ISO 11352:2012. Water quality – Estimation of measurement uncertainty based on validation and quality control data (www.iso.org)
- ISO 19036:2019. Microbiology of the food chain – Estimation of measurement uncertainty for quantitative determinations (www.iso.org)
- ISO/TS 20914:2019. Medical laboratories – Practical guidance for the estimation of measurement uncertainty (www.iso.org)
- ISO 21748:2017. Guidance for the use of repeatability, reproducibility and trueness estimates in measurement uncertainty estimation (www.iso.org)
- ISO/TS 21749:2005. Measurement uncertainty for metrological applications – Repeated measurements and nested experiments (www.iso.org)
- ISO/TS 28037:2010. Determination and use of straight line calibration functions (www.iso.org)

Guides

- A. Williams and B. Magnusson (Eds) Eurachem/CITAC Guide: Use of uncertainty information in compliance assessment (2nd ed. 2021). ISBN 978-0-948926-38-9 (www.eurachem.org)
- R. Bettencourt da Silva, A. Williams (Eds) Eurachem/CITAC Guide: Setting and using target uncertainty in chemical measurement (2015). ISBN 978-989-98723-7-0 (www.eurachem.org)
- S. L. R. Ellison, A. Williams (Eds) Eurachem/CITAC Guide: Quantifying uncertainty in analytical measurement (3rd ed. 2012). ISBN 978-0-948926-30-3 (www.eurachem.org)
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- Decision rules applied to conformity assessment, Technical report No. 01/2017, EUROLAB, 2017 (www.eurolab.org)
- B. Magnusson, T. Näykki, H. Hovind, M. Krysell, Handbook for calculation of measurement uncertainty in environmental laboratories, Nordtest Report TR 537 ed 4:2017 (www.nordtest.info)
- EA-4/02 M, Evaluation of the uncertainty of measurement in calibration, 2022 (www.european-accreditation.org)
- Measurement uncertainty revisited: Alternative approaches to uncertainty evaluation, Technical report No. 1/2007, EUROLAB, 2007 (www.eurolab.org)

- Guide to the evaluation of measurement uncertainty for quantitative tests results, Technical report No. 1/2006, EUROLAB, 2006 (www.eurolab.org)
- Measurement uncertainty in testing, Technical report No. 1/2002, EUROLAB, 2002 (www.eurolab.org)
- Guidelines on Measurement Uncertainty, Codex Alimentarius, CXG 54-2004, 2021, (https://www.fao.org/fao-who-codexalimentarius)

Books

- N. Majcen and V Gegevičius (Ed.), Analytical measurement: measurement uncertainty and statistics, 2012, European Commission, Joint Research Centre, ISBN 978-92-79-23071-4 (https://bookshop.europa.eu/en/home/)
- N. Majcen, P. Taylor, T. Martišius, A. Menditto, M. Patriarca, Practical examples on traceability, measurement uncertainty and validation in chemistry Vol 2, 2011, European Commission, Joint Research Centre (https://bookshop.europa.eu/en/home/)
- N. Majcen, P. Taylor, L. Benedik, Practical examples on traceability, measurement uncertainty and validation in chemistry Vol 1, 2010, European Commission, Joint Research Centre (https://bookshop.europa.eu/en/home/)

Leaflets

- Eurachem information leaflets (www.eurachem.org)
  - What is the uncertainty factor? (2021)
  - Use of uncertainty information in compliance assessment (updated 2021)
  - Setting target measurement uncertainty (2018)
  - Treatment of an observed bias (2017)
  - Using repeated measurements to improve the standard uncertainty (2nd edition, 2016)
  - Important information to our customers concerning the quality of measurements (2000)
- Eurolab cookbooks (https://www.eurolab.org/pubs-cookbooks)
  - Doc No. 8, Determination of conformance with specifications using measurement uncertainties – possible strategies, revision no. 3, 09/2018
- AMC Technical Briefs, RSC, (https://www.rsc.org/membership-and-community/connect-with-others/join-scientific-networks/subject-communities/analytical-science-community/amc/technical-briefs/):
  - AMC TB 112-2022, Comparing measurement uncertainty values, https://doi.org/10.1039/D2AY90114E
  - AMC TB 105-2020, How reliable is your uncertainty estimate? https://doi.org/10.1039/D1AY90060A
  - AMC TB 88-2019, Why do we need the uncertainty factor?, https://doi.org/10.1039/C9AY90050K
  - AMC TB 53-2012, Dark uncertainty, https://doi.org/10.1039/C2AY90034C

  Under Statistical Analysis tab
  - AMC TB 32-2008, Optimising your uncertainty – a case study
  - AMC TB 26A-2008, Measurement uncertainty and confidence intervals near natural limits
  - AMC TB 22-2006, Uncertainties in concentrations estimated from calibration experiments
  - AMC TB 21A-2008, The estimation and use of recovery factors

- AMC TB 15-2003, Is my uncertainty estimate realistic?

Articles and reports

- A. C. Olivieri, N. M. Faber, J. Ferré, R. Boqué, J. H. Kalivas, H. Mark, Uncertainty estimation and figures of merit for multivariate calibration, IUPAC Technical Report, Pure Appl. Chem., 2006, 78(3), 633-661, https://doi.org/10.1351/pac200678030633
- J. Kragten, Calculating standard deviations and confidence intervals with a universally applicable spreadsheet technique, Analyst, 1994, 119, 2161-2166, https://doi.org/10.1039/AN9941902161

Software

- ForMEQ – Spreadsheet for automatizing conformity assessments (English Version), May 2020 (https://formeq.org/avaliacao-automatica-de-conformidade/)
- MUkit – measurement uncertainty kit (English version), v 3.0, 2022, (https://www.syke.fi/en-US)

Qualitative analysis

Standards

- ISO/TR 79:2015, Reference materials – Examples of reference materials for qualitative properties (www.iso.org).
- ISO 33406:2024, Guidance for the production of reference materials with qualitative properties (under publication, www.iso.org)

Guides

- R. Bettencourt da Silva and S. L. R. Ellison (Eds.). Eurachem/CITAC Guide: Assessment of performance and uncertainty in qualitative chemical analysis. (2021). ISBN 978-0-948926-39-6 (www.eurachem.org)
- G. Nordin, R. Dybkaer, U. Forsum, X. Fuentes-Arderiu and F. Pontet, Vocabulary on nominal property, examination, and related concepts for clinical laboratory sciences (IFCC-IUPAC Recommendations 2017), Pure Appl. Chem., 2018, 90(5), 913-935, https://doi.org/10.1515/pac-2011-0613

Books

- P. Pereira, Quality control of qualitative tests for medical laboratories, 2019, Lisbon: Author-edition, ISBN 978-989-20-9857-9

Articles and reports

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Sampling

Guides

- M. H. Ramsey, P. D. Rostron, F.C. Raposo (Eds.) Eurachem/EUROLAB/CITAC/Nordtest/AMC Guide: Validation of measurement procedures that include sampling, (2024) (www.eurachem.org)
- M. H. Ramsey, S. L. R. Ellison and P. Rostron (Eds.) Eurachem/EUROLAB/CITAC/Nordtest/AMC Guide: Measurement uncertainty arising from sampling: a guide to methods and approaches. (2nd ed., 2019). ISBN 978-0-948926-35-8 (www.eurachem.org)
- B. Magnusson, M. Krysell, E. Sahlin and T. Näykki, Uncertainty from sampling – A Nordtest Handbook, Nordtest Report TR 604 ed 2:2020 (www.nordtest.info)

Leaflets

- Eurachem-AMC Information Leaflet (www.eurachem.org)
    - What is the uncertainty factor? (2021)
- AMC Technical Briefs, RSC, (https://www.rsc.org/membership-and-community/connect-with-others/join-scientific-networks/subject-communities/analytical-science-community/amc/technical-briefs/):
    - AMC TB 114-2024, Improved estimates of expanded measurement uncertainty http://dx.doi.org/10.1039/d4ay90083a
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- AMC TB 16A-2004, What is uncertainty from sampling, and why is it important?

Under Statistical Analysis tab

- AMC TB 64-2014, Unbalanced robust ANOVA for the estimation of measurement uncertainty at reduced cost, https://doi.org/10.1039/C4AY90062F

Under Quality Control tab

- AMC TB 42-2009, The importance, for regulation, of uncertainty from sampling

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- M. H. Ramsey, GGR Handbook of Rock and Mineral Analysis Chapter 1 (Part 2) Sampling as Part of the Measurement Process, Geostandards and Geoanalytical Research, 2024, 48, 4, 719-736 http://doi.org/10.1111/ggr.12586
- M. H. Ramsey, Estimation and usefulness of measurement uncertainty from sampling at different spatial scales: microns to kilometres, Environ Geochem Health, 2024, 46:115 https://doi.org/10.1007/s10653-024-01888-6
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