CCQM WG on Electrochemical Analysis and Classical Chemical Methods

The bilateral comparison CCQM-K170.1

Electrolytic Conductivity at 0.5 S m^{-1}

Technical protocol

Purpose of the comparison

This bilateral comparison, linked to CCQM-K170, will be performed to demonstrate the capability of NPLI to measure the electrolytic conductivity of an aqueous electrolyte solution in the range around 0.5 S m^{-1}. To this end, the electrolytic conductivity of a potassium chloride solution with a nominal electrolytic conductivity of 0.5 S m^{-1} will be measured.

The results of the bilateral comparison may provide supporting evidence for the respective CMC claims of NPLI.

Proposed time schedule

Dispatch of samples:	February 2027
Reporting deadline:	May 2027
Draft A report:	July 2027
Discussion:	EAWG meeting, Autumn 2027
Draft B report:	November 2027

Description of the sample

The solution used for this comparison was prepared by the coordinating laboratory.

A potassium chloride (KCl) solution with nominal electrolytic conductivity values of approximately 0.5 $S \cdot m^{-1}$ was prepared using potassium chloride and purified water. After preparation, the solution was thoroughly homogenized and dispensed into 500 mL HDPE bottles fitted with an aluminum heat seal liner and polypropylene screw caps. To minimize water evaporation, the caps were sealed with Parafilm and each bottle was enclosed in an aluminum-laminated bag.

The bottle labels included the identification “bilateral comparison”, “laboratory water”, the nominal electrolytic conductivity value, the filling date, and the bottle number. Participants will receive two bottles of KCl solution. The bottles were wrapped in bubble wrap, packed in cardboard boxes, and dispatched by courier service. Tracking numbers were provided by email to the designated laboratory contact persons. The shipment contents were declared as “aqueous solution for electrolytic conductivity measurements” with a customs value of USD 1 per bottle. Any specific customs requirements provided by participating laboratories were considered.

The homogeneity of each solution was evaluated using measurements from five randomly selected bottles prior to shipment. Stability studies were initiated after preparation and performed at four-week intervals throughout the entire measurement period.

Actions after receipt of the samples

1. The packaging material must be removed after arrival of the samples and the bottles must be inspected for any visible damage or leakage.
2. The bottles shall be equilibrated in the weighing room overnight. The Parafilm sealing of the cap of the KCl samples and the labels must not be removed for weighing. Each bottle shall be weighed with a balance having 0.01 g resolution to verify its integrity during shipment. The weighing results, the pressure, the temperature and the relative humidity at the time of weighing should be reported in the weighing excel sheet.
3. The sample receipt and the measured masses (not corrected for air buoyancy), pressure, temperature and relative humidity of the bottles must be reported to the coordinating laboratory by email within two weeks of sample arrival. Any mishaps should be reported immediately. If a bottle is damaged, a replacement bottle will be sent.

Instructions for Participants

1. The bottles should be stored at temperatures between 20°C and 25°C, however, they must not be stored above 25°C. The caps of the bottles may only be opened immediately before the measurements. If possible, the caps should be re-sealed with Parafilm following each opening.
2. Each participant has to measure electrolytic conductivity of the samples with respect to 25°C using the method its existing or planned CMC claims are referring to. Additional data at 24°C and 26°C are also welcome, allowing for the calculation of temperature coefficient of each solution.

Reporting

A measurement report must be written, containing the following information:

1. Name and address of the laboratory performing the measurements.
2. Name(s) of the operator(s).
3. Date of receipt of samples.
4. Identification of the samples (bottle numbers) measured.
5. Date(s) of measurement.
6. Mass of each bottle (without buoyancy correction), pressure, temperature, and relative humidity at the time of weighing.
7. Description of the method used, including a photo of the experimental setup, if available.
8. Complete uncertainty budget according to the Guide to the Uncertainty in Measurement. All significant uncertainty sources must be accounted for.
9. The measurement results with the associated standard uncertainties, expanded uncertainties and the corresponding coverage factors *k*, referring to a 95.45% probability interval. Note that *k* is 2 if an infinitive number of degrees of freedom can be reasonably assumed.
10. Metrological traceability of the measurement results.

The report must be sent to the coordinating laboratory before 31 May 2027 by e-mail. To ensure data integrity, the report should preferably be provided in PDF format. The coordinating laboratory will acknowledge receipt of the report. If no confirmation is received within one week of submission, please contact the coordinating laboratory to investigate and resolve any potential issues.

Additionally, a word template will be provided for the submission of a summary of the results. Participants shall report only one result for each solution. The completed summary report may be submitted as a separate document or incorporated into the measurement report.

Link to CCQM-K170

The degree of equivalence (*DoE*) of the participant ($DOE_{BC}(x_{NPLI})$ will be calculated using the *DoE* of the linking laboratory obtained from CCQM-K170 ($DOE_{OC}(x_{ll})$) and the difference between the measurement results of the participant, x_{NPLI}, and the linking laboratory (x_{ll}), as expressed in the equation below.

$$DOE_{BC}(x_{NPLI}) = x_{NPLI} - x_{ll} + DOE_{OC}(x_{ll}) \qquad (1)$$

$$U^2 DOE_{BC}(x_{NPLI}) = U^2(x_{NPLI}) - U^2(x_{ll}) + U^2(DOE_{OC}(x_{ll})) \qquad (2)$$

x_{NPLI}	measurement result of participant (NPLI) in this bilateral comparison
x_{ll}	measurement result of the linking laboratory in this bilateral comparison
DoE_{BC}	DOE in this bilateral comparison
DoE_{oc}	DoE in the original comparison CCQM-K170

A draft A report based on the reported results will be prepared and circulated to the participant for comment. The report will subsequently be discussed at the meetings of the CCQM Working Group on Electrochemical Analysis.

Key comparison reference value

The results will be compared with the Key Comparison Reference Value (KCRV) of CCQM-K170. The link to the KCRV will be established through the linking measurements provided by NIMT, acting as the linking laboratory in this bilateral comparison.

How Far the Light Shines statement

The HFTLS statement is effectively the same as that of the original comparison. The results will be used to demonstrate measurement capability for electrolytic conductivity measurements of aqueous electrolyte solutions in the conductivity range from 0.15 S m^{-1} to 1.5 S m^{-1}.

Contact person and coordinating laboratory

Wiphada Hongthani
National Institute of Metrology Thailand (NIMT)
3/4-5 Moo 3, Klong 5, Klong Luang,
Pathumthani 12120 Thailand
Tel.: +66 (0)2 026 5400 ext. 5602
Email: wiphada@nimt.or.th
Alternative contact:
Sutthinun Taebunpakul
Email: Sutthinun@nimt.or.th