

Template for comments and secretariat observations

Date:2021-02-16

Document: Traceability of electrolytic conductivity measurements results

Project: TC 17/SC 4/p 1

MB/ NC ¹	Line number	Clause/ Subclause	Paragraph/ Figure/Table	Type of comment ²	Comments	Proposed change	Observations of the secretariat
DE 001	3			ge	The structure of the document has improved a lot. However, chapter 3 is still confusing. It is somewhat redundant (3.1 and 3.3 cover the topic from different perspectives). Then there is a measurement section about temperature and uncertainty, which do not really fit into the traceability topic of 3.	This is a rather general chapter with little practical use. It should be kept significantly shorter, it should be restructured and it must be more concise with respect of its intention. 3.4 and 3.5 must be included elsewhere.	Taken into account. Paragraph 3 is edited as recommended. Items 3.1 and 3.2 are worded according to the recommendations of OIML D5: «Principles for the establishment of hierarchy schemes for measuring instruments».
DE 002	Ap A				k should be Greek “kappa”		Accepted.
DE 003	Ap A				wrong term “Reproducibility”	Replace by “Realisation”	Accepted.
DE 004	Ap A				“The reference procedure for cell constant”	Replace by “The reference procedure for cell constant measurement”	Accepted.
DE 005	Ap A				“Working conductivity instruments”	just “conductivity measurement device”	Accepted.
DE 006	Ap B				Form only applies to recipe-based solutions.	Either adapt the title or make the form more general so that is cab used for all the routes of traceability. Actually, I would recommend not to provide a template at all. Instead some general requirements should be stated that just list necessary information that a report must include (have a look at IEC 17025, which states general requirements for calibration certificate and is a good example)	Accepted.
DE 007	1	1.8	1	ge	the definition of NMI is strange	I assume that there is an OIML definition that should be used	Rejected. The definition corresponds to 3.2.2 and 3.2.3 of OIML D1.
DE 008	3	3.3	1	ed	the expression “an experimental-calculation method of the unit realization” is rather unusual and confusing. Its meaning is not clear.	I would propose to delete the whole sentence: “... highest accuracy. The EC of the primary standard is linked ...”	Partly accepted.

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							Examples of the experimental calculation method for creating reference standards are the "Calculated Capacitor (Thomson-Lampard method)", van der Pauw method (calculated specific conductivity) in which the value of the conductive constant is calculated from a single measurement of the cell geometry. Conductometric cells that implement this method also include Jones cells and RTB sensor.
DE 009	3	3.3	level 2	ge	Misleading: "The number of secondary standards and their locations depends on geographic position, economic or political organization of the country."	Replace: "The use of secondary standards depends on geographic location, economic or political organization of a country. Often, secondary standards are used by calibration labs. Likewise, a sentence "Primary standards are typically used by NMIs" should be added in level 1.	Accepted.
DE 010	3	3.3	Note	ge	Reference to Van der Pauw and Lampard theorems is misleading. They have never left the research stage. In calibration practice they are not used at all.	delete the reference.	In the USSR, the first such cell was patented back in 1976. In the 1980s, cells based on this principle were developed by Indian scientists. An experimental sample of a cell based on the van der Pauw method was presented by the USSR at an exhibition in Germany. Modern technology is able to implement the primary standard of specific conductivity according to the van der Pauw method.
DE 011	3	3.3	Note	ge	There is no Wu-cell. Wu used the cell introduced by Jones.	Replace note by "The Jones-cell is an example of a primary measurement cell".	Accepted.

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DE 012	3	3.4	1	te	unit for the temperature coefficient is missing	"For KCl solutions it is 0.0195/K at 25°C	Accepted.
DE 013	3	3.5	1	ge	not clear what is meant by "order of their value"?	why not just using "their value"?	Accepted.
DE 014	3	3.5	1	ge	GUM does not give any recommendation about uncertainty limits that have to be kept. Technical standards give limits with respect to specific applications (e.g. pharmacopeias for pure water conductivity)	delete "and the limit to keep within" and continue with ... values. Uncertainties are determined	Accepted.
DE 015	3	3.5	2	te	the sentence "The proportion of the increase in the associated measurement uncertainty can vary from 2:1 to 3:1 depending on the value of the EC measurement range." is technically wrong. The uncertainty of a secondary standard can be almost as good as that of the primary standard used for calibration, due to the strong correlation of temperature and resistance measurements of the calibration procedure (first primary then secondary standard using the same device (see ref [1])).	delete the sentence	Accepted.
DE 016	4	4.1.1	1	te	the sentence "The uncertainty of the value K is the prevailing component of the general estimate of the conductivity measurement uncertainty." is not necessarily true for the same reason as mention in the previous comment.	delete the sentence	Taken into account.
DE 017	4	4.3.4	1	ge	this requirement cannot be applied with commercial measuring devices, since users do not have control over the kind of measurement signal	must be formulated in terms that are more applicable	Rejected. Both the cell constant and the EC value depend on the frequency of the applied voltage. This dependence is well demonstrated by the equivalent cell diagram. Most commercial conductivity meters provide this information in their technical files.

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DE 018	4	4.3.5	1	ge	like in the previous comment the resistance value is often not available to the user, thus, this requirement cannot be fulfilled	express in terms of conductivities, which are available by the user	Accepted.
DE 019	4	4.4		te	“error” is not the same as “uncertainty” (see VIM). Here the text refers to uncertainty	replace “error” by “uncertainty”.	Accepted.
DE 020	4	4.4	3	te	the uncertainties assigned to solution preparation are not complete	add “impurities of KCl, effect of CO ₂ on the EC of water”	Accepted.
DE 021	4	4.4	5	te	The uncertainty of the resistance measurement is irrelevant in a secondary measurement (see ref [1]). In fact, the instrument is calibrated with a conductivity standard to assign the EC value. If there is an error in R it is compensated by K. That’s the principle of the calibration. Thus, uncertainty in R doesn’t matter. Its only the stability and repeatability of the R measurement (actually the conductivity measurement) that has to be considered in this regard.	delete	Accepted.
DE 022	4	4.4	note	te	The note is misleading. For the reason mentioned in the previous comment, such systematic uncertainties do usually not contribute to the combined uncertainty. However, a change of parts of the measurement set-up (e.g. wires or the thermostat) between the calibration measurement and a subsequent EC measurement might introduce additional uncertainties.	adapt text appropriately	Taken into account.
DE 023	4	4.5	4	ge	see comment to above regarding voltage frequency (4.3.4)	see respective proposal	Taken into account.
DE 024	4	4.5	5	ge	see comment above regarding resistance (4.3.5)	see respective proposal	Taken into account.
DE 025	5	5.1	05.1.1	te	the statement in brackets “(potassium chloride aqueous solutions with a known molarity)” contradict the second half of the sentence “with EC values determined by measurements from accredited laboratories or NMIs”. Either the value is determined by NMIs or its assigned by using table 1.	replace by “5.1.1 It is recommended to use CRMs, with EC values determined by accredited laboratories or NMIs, to calibrate conductivity meters.” It is not necessary to mention how a specific NMI/DI, accr. lab has done this.	Accepted.

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DE 026	5	5.1	05.1.2	ge	should be expressed as an alternative to 5.1.1	“Alternatively, KCl solutions of specific mololities with assigned EC values and uncertainties (see table 1) can be used to calibrate conductivity measurement devices.”	Accepted.
DE 027	5	5.3		ed	title does not reflect content, which is about uncertainty of the calibration of conductivity measurement device using secondary and working standards	adapt title	Accepted.
DE 028	5	5.3	05.3.1		sub chapter does not fit to 5.3	shift this section to 5.2, since it belongs to that section	Accepted.
DE 029	5	5.3	05.3.2	ge	most of the documents is written in terms of resistances, here now conductance is used	rephrase in terms of resistances for internal consistency	Accepted.
DE 030	5	5.3	05.3.2	ge	again, G (or R) is often not available using commercial devices	rephrase in more general terms, i.e. including conductivity	Accepted.
DE 031	5	5.3	05.3.2	ed	G0 is not the “conductance cell value”, but the mean of the individually measured conductances, measured with a conductance measurement cell.	correct; actually all “conductance cell values” have to be replaced accordingly	Accepted.
DE 032	5	5.3	05.3.3	te	uncertainty of conductance measurement needs not be considered (see above). Uncertainty of CO2 is included in the EC value of the water used to prepare the solution.	delete both contributions	Accepted.
DE 033	5	table 1			commas as decimal are unusual in English	replace by dots	Accepted.

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