Making measurement results metrologically traceable to SI units requires more than just expressing them in SI units

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There is a persistent fallacy in the literature in which “traceability to the SI” is claimed if the measurement result is just reported in SI units.

Traceability is a general (“superordinate”) concept, applicable in many fields. One can talk about traceability of a sample of material; thus, identifying its physical origin, or about traceability of a document to its issuing organization (documentary traceability), or certificate (traceability to a responsible signature), and others.

In any measurement context, the most important type of traceability is ‘metrological traceability’. It is the traceability of a measurement result to the value embodied in—or carried by—a “reference” when obtaining a measurement result for a measurand [1]. This reference can be

- “a definition of a measurement unit through its practical realization” [2],
- “a measurement procedure including the measurement unit for an ordinal quantity” [2], or
- “a measurement standard” [2], such as a “calibrator” [3].

Such metrological traceability can be short and simple such as ‘metrological traceability to a measurement unit’ [4] which always means to the value of that unit. In most cases, that is the numerical value 1. If that unit is a (base or derived) unit of the “Système International d’Unités” (well known as the SI), it is customary to talk about “traceability to the SI” [5]. A measurement unit has no measurement uncertainty as it is not measured, but defined.

However, it is not sufficient to name a unit in a measurement result to be metrologically traceable to that unit.

The metrological traceability must be to ‘a measurement unit through its practical realization’ [2] of that measurement unit. In other words, the ‘metrological traceability chain’ [6] must be established from the (value of the) measurement result to the value embodied in—or carried by—a material,—or obtained by—a measurement procedure [2].

Thus, metrological traceability to a unit (e.g. an SI unit) implies metrological traceability to a material realization of the definition of that unit.

‘Metrological traceability’ is not just a simple “statement”, it must be based on an unbroken chain of quantity values embodied in a specified material. It must be possible to present a metrological traceability chain, either declared—or at least be presented on request—if the result is to be credible. Just a statement of the unit used, be it an SI unit, is not sufficient.

A visible metrological traceability chain is a key property of any measurement result.

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P.S. By the way, looking for a justification for MiC?

An error of 1% in the measurement of the annual amount of natural gas traded in Europe (a commercial value of about €700 000 000 000) corresponds to a value of roughly €7 000 000 000; an error of 0.1% corresponds to somewhat less than €1 000 000 000. Taking into account that measurements take place in pipelines and oil storage tanks where one has not only to measure volume but also temperature, pressure and chemical composition, a

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measurement uncertainty of somewhere between 1 and 0.1% is not likely to be realized.

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