

## **Title: Metrology for the determination of emissions of dangerous substances from building materials into indoor air**

### **Abstract**

European citizens spend more than 80 % of their time indoors. Based on EU regulation No 305/2011/EU, EN 16516 establishes a mandatory test procedure for the determination of emissions of dangerous substances from building materials into indoor air by use of emission test chambers. However, reliability and comparability of measurement results is currently compromised due to the lack of emission reference materials (ERM) and appropriate gaseous certified reference materials (CRM). To overcome these gaps, research is needed i) to develop a well-defined ERM with constant emissions over the short term, and ii) to develop traceable CRMs. Through these new ERM and CRM, reliable comparability of indoor air emission measurements will be ensured.

### **Keywords**

EN 16516, indoor air, emission reference materials, reference gas standards, material emissions, emission test chamber, volatile organic compounds

### **Background to the Metrological Challenges**

In industrialised countries, about 80 % of our time is spent indoors. Products, such as building materials and furniture emit volatile organic compounds (VOCs), which are therefore ubiquitous in indoor air. VOC emissions might cause health issues often referred to as the “Sick Building Syndrome” (SBS). A healthy indoor environment can be achieved by controlling the sources and by eliminating or limiting the release of harmful substances into the air. One way is to use (building) materials proved to be low emitting. EU regulation No 305/2011/EU lays down basic requirements for construction works, saying that they should “not be a threat to the hygiene or health and safety of workers, occupants or neighbours [...] as a result of [...] the emissions of dangerous substances, volatile organic compounds, greenhouse gases or dangerous particles into indoor or outdoor air [...]”

As requested by mandate M/366, CEN/TC 351/WG 2 has developed the European testing standard EN 16516, which was published in 2017 and describes a mandatory procedure for the determination of building material emissions into indoor air by the use of emission test chambers. During the last decades, a dense network of professional commercial and non-commercial testing institutes has been established in Europe dealing with such tests. Since their results are used for the health-related evaluation of building materials, comparability between the measurements is important.

- EN 16516 requires that “notified and accredited laboratories shall verify performance of the whole method by comparing against external references [...]. Participation in round robin tests and relevant independent analytical proficiency testing schemes is useful [...] and is strongly recommended”. To enable these verifications, stable ERMs are urgently needed. Since such suitable emission RMs are currently not available on the market, commercial products are used for this purpose (e.g. flooring, paints, etc.). However, these products show a lack of reproducibility. In previous round robin tests (RRT) performed with commercial materials, unacceptable relative standard deviations of reproducibility between labs ranging from 46 % up to 300 % were reported. This instance underpins the need for ERMs with reproducible and homogenous emission properties.
- Apart from the ERMs applied for checking the overall emission test chamber procedure, also the availability of primary reference gas standards for dangerous substances occurring in indoor air is still unsatisfactory. They are urgently needed for the quality control and the calibration of the analysis of the test chamber air. Experts from EU member states published a roadmap towards an EU-wide harmonised framework for the health-based evaluation of indoor emissions from construction products

(ECA report No 29). Relevant target compounds to be identified and traceably quantified in the test chamber air are listed on the EU-LCI list. The problem is that CRMs are only available for a small number of these compounds. Of particular need are standards for aldehydes, e.g. glutaral and furfural, unsaturated aldehydes, e.g. butenal, cyclic dimethylsiloxanes (D3-D6) and glycol compounds, e.g. diglyme and 2-methoxypropanol. Here, also the substance groups of the VVOC and SVOC are of great importance.

The proposed research of this SRT conforms with the needs CEN/TC 351/WG 2 has expressed as to the development of suitable reference materials and reference gas standards (CEN/CENELEC priority topic No 3).

## Objectives

Proposers should address the objectives stated below, which are based on the PRT submissions. Proposers may identify amendments to the objectives or choose to address a subset of them in order to maximise the overall impact, or address budgetary or scientific / technical constraints, but the reasons for this should be clearly stated in the protocol.

The JRP shall focus on enabling the traceable measurement of emissions of volatile organic compounds (VOC) from materials for interior use and allowing for comparability of measurement results and mitigation of the measurement uncertainty. This shall be reached by the development of well-defined emission reference materials (ERM) and primary reference gas standards (RGM) of indoor air pollutants serving as external references demanded by EN 16516.

The specific objectives are

1. To develop an emission reference material (ERM) for QA/QC of the emission chamber test method, as described in EN 16516, based on materials with temporarily constant emission profiles, or at least a significantly decelerated decline of the emission profile over time as compared to the state of the art. A period of at least 14 days should be the target for this consistent emission. The ERM should contain and release a number of relevant compounds typically found in indoor air, e.g. n-hexane, 4-methyl-2-pentanone, toluene, butyl acetate, cyclohexanone, o-xylene, phenol, 1,2,3-trimethylbenzene.
2. To develop a suitable thermodynamic physical model describing transport processes both inside the ERM and of the compound release into the emission test chamber, thereby enabling the prediction of the emissions for each selected target VOC. The model aims to support the customised generation of the final product developed in objective 1.
3. To develop primary gas standards and CRMs of selected compounds relevant for the health-related evaluation of building products listed on the EU-LCI-list. Important compound groups are aldehydes (e.g. glutaral and furfural), unsaturated aldehydes (e.g. butenal), cyclic dimethylsiloxanes (D3-D6) and glycol compounds (e.g. diglyme and 2-methoxypropanol). The list should not be limited to the group of VOCs but may also contain Very Volatile Organic Compounds (VVOC) and Semi-Volatile Organic Compounds (SVOC) according to the definitions in EN 16516.
4. To validate the newly developed ERM and CRMs. The validation work should involve investigations on homogeneity, long-term stability and reproducibility, and must include an inter-laboratory comparison to investigate the performance of the ERM and CRMs, thereby demonstrating the value of the reference materials for the test procedure demanded by EN 16516.
5. To collaborate with CEN/TC 351/WG 2 "Emissions from construction products into indoor air" on CEN/CENELEC priority topic No 3, and other standardisation, regulatory and accreditation communities (ISO/TC 146/SC 6 "Indoor air", EU-LCI working group) to ensure that the outputs of the project are aligned with their needs, communicated quickly to those developing the standards and to those who will use them, and in a form that can be incorporated into the standards at the earliest opportunity. The end users, i.e. testing laboratories, should be kept informed about the project's progress and considered for participation in the inter-laboratory comparison in objective 4.

The proposed research shall be justified by clear reference to the measurement needs within strategic documents published by the relevant Regulatory body or Standards Developing Organisation or by a letter signed by the convenor of the respective TC/WG. EURAMET encourages proposals that include representatives from industry, regulators and standardisation bodies actively participating in the projects. The proposal must name a "Chief Stakeholder", not a member of the consortium, but a representative of the user community that will benefit from the proposed work. The "Chief Stakeholder" should write a letter of support explaining how their organisation will make use of the outcomes from the research, be consulted regularly by

the consortium during the project to ensure that the planned outcomes are still relevant, and be prepared to report to EURAMET on the benefits they have gained from the project.

Proposers should establish the current state of the art and explain how their proposed research goes beyond this.

In particular, proposers should outline the achievements of the EMRP projects ENV01 MACPoll and ENV56 KEY-VOCs and how their proposal will build on those.

EURAMET expects the average EU Contribution for the selected JRPs in this TP to be 0.8 M€ and has defined an upper limit of 1.0 M€ for this project.

EURAMET also expects the EU Contribution to the external funded partners to not exceed 30 % of the total EU Contribution across all selected projects in this TP.

Any industrial partners that will receive significant benefit from the results of the proposed project are expected to be unfunded partners.

## Potential Impact

Proposals must demonstrate adequate and appropriate participation/links to the “end user” community, describing how the project partners will engage with relevant communities during the project to facilitate knowledge transfer and accelerate the uptake of project outputs. Evidence of support from the “end user” community (e.g. letters of support) is also encouraged.

You should detail how your JRP results are going to:

- Address the SRT objectives and deliver solutions to the documented needs,
- Feed into the development of urgent documentary standards through appropriate standards bodies,
- Transfer knowledge to the materials and manufacturing sector.

You should detail other impacts of your proposed JRP as specified in the document “Guide 4: Writing Joint Research Projects (JRPs)”

You should also detail how your approach to realising the objectives will further the aim of EMPIR to develop a coherent approach at the European level in the field of metrology and include the best available contributions from across the metrology community. Specifically, the opportunities for:

- improvement of the efficiency of use of available resources to better meet metrological needs and to assure the traceability of national standards
- the metrology capacity of EURAMET Member States whose metrology programmes are at an early stage of development to be increased
- organisations other than NMIs and DIs to be involved in the work.

## Time-scale

The project should be of up to 3 years duration.

## Additional information

CEN/CENELEC identified this topic as one of their priorities. Details are available at:

[https://msu.euramet.org/current\\_calls/pre\\_norm\\_2019/documents/cen\\_priority\\_003.pdf](https://msu.euramet.org/current_calls/pre_norm_2019/documents/cen_priority_003.pdf)

The references were provided by PRT submitters; proposers should therefore establish the relevance of any references.

[1] M/366, 2005: Development of horizontal standardised assessment methods for harmonised approaches relating to dangerous substances under the Construction Products Directive (CPD)

[2] CEN/TC 351/WG 2: Emissions from construction products into indoor air