Publishable Summary for 14SIP03 Autopart - Automotive particle emissions: dissemination of aerosol measurement expertise to standards bodies

Overview

This project ensured that SI traceability and measurement good practice in the area of airborne particle number concentration measurement was incorporated into the relevant CEN and ISO standards and PMP (Particle Measurement Programme) documents. This should enable a more efficient and reliable implementation of the regulations covering particle emissions from vehicles (Regulation No 83 of the UN/ECE), whilst also supporting similar measurements in other areas like air quality.

Need

Particles suspended in the air around us have sizes between a few nanometres and hundreds of microns. These particles are a serious human health issue across Europe, and also world-wide. Their health effects, via inhalation, are far greater than those from gaseous air pollutants, and they are deemed to be responsible for at least 492,000 premature deaths per year within the EU. Health effects are dominated by particles of less than a few microns in size.

Air Quality legislation such as Directive 2008/50/EC requires EU member states to limit concentrations of airborne particles to which populations are exposed, but the complex nature of the sources means that a good quantitative understanding of the types of particle present is needed to decide the most appropriate actions to take.

The work of the EMRP project ENV02, whose stakeholders included major European vehicle manufacturers and several relevant instrument manufacturers, addressed important current issues relating to nanoparticle emissions from vehicles, such as providing traceability for instrument calibration and providing a working definition of size for particles below 80 nm.

EU rules covering vehicle emissions are set out in Amendments to the 1970 Directive 70/220/EEC, known as the EURO series. The EURO 5 and 6 vehicle regulations specify limits on emitted nanoparticle numbers. Methods are set out in UN/ECE Regulation 83, but significant aspects, such as the particle material to be used for calibration, need to be addressed.

EMRP ENV02 established preferred types of particle, such as silver and "soot-like", and preparation methods for vehicle emission requirements. International standardisation of these measurements has begun relatively recently within ISO TC24 SC4 WG12, which addresses general measurement issues relating to particle number concentration and size distribution, and CEN TC264 WG32, which addresses number concentration and size distribution specifically for air quality purposes.

The need for this project was to assist the take-up of the results from EMRP project ENV02 by these user communities.

Objectives

Taking into account the need, the objectives of the project were in two distinct areas, relating firstly to the vehicle emission regulation community and secondly to the standardisation community covering the measurement techniques at a more general level:

1. To ensure the results from project ENV02 WP1, and good metrological practice in the area of aerosol measurement more generally, are understood by key PMP members and incorporated into PMP documents.

   To be more specific, the calibration of aerosol electrometers and Condensation Particle Counters (CPCs) is explicitly required in PMP documents, and traceability chains for these have been made available through the facilities developed during EMRP ENV02; also, the findings about the most practical and reproducible particle sources, to provide a consistent basis for calibration and regulation, need to be more widely known and incorporated into the PMP documents.

2. To ensure the results from ENV02 WP1, and good metrological practice in the area of aerosol measurement more generally, are understood by key members of relevant CEN and ISO committees, specifically CEN TC264 WG32 and ISO TC24 SC4 WG12, and incorporated into CEN and ISO standards.

   To be more specific, the EMRP ENV02 consortium released a recommendation on how to calibrate the particle size selection of Differential Mobility Analysers (DMAs), which will be relevant to the upcoming revision of ISO 15900:2009: *Determination of particle size distribution -- Differential electrical mobility analysis for aerosol particles*. At the same time, CEN TC 264 WG 32 is working in a Technical Specification *Ambient air - Determination of the particle size spectra of atmospheric aerosol using a Mobility Particle Size Spectrometer (MPSS)*.

Results

The outputs of the project relating to each objective are as follows:

Results in relation to objective 1.

There has been extensive direct interaction with the PMP community over the course of the project, via face-to-face meetings involving PTB, during which metrological requirements were discussed. The practical aspects of the measurements were evaluated in a “round robin” PMP comparison exercise for CPCs held at PTB in June 2016, for which the JRC Technical Report has been submitted.

A sub-group was set up during the March 2017 meeting consisting of stakeholders in the automotive industry and device manufacturers. The scope of the sub-group was related to the activity of this project. A first guideline was discussed for the revision of Particle Number Counter Calibration Procedure for engine exhaust CPCs (ED47382004/PNC - Issue 5), which is the current industrial guideline for the calibration of PMP-compliant CPCs used for the type evaluation (homologation) of car engines (Otto/Diesel).

The work of the project has been disseminated in several presentations, for example at the 21st ETH Combustion Generated Nanoparticles conference in Zurich in June 2017, where a talk was given by BMW and PTB presenting the results of the first round-robin exercise for engine exhaust CPCs.

Results in relation to objective 2

There has been direct interaction with the ISO and CEN communities throughout the project via NPL participation in a total of 13 ISO 24 SC4 and CEN TC 264 WG 32 meetings.

ISO 24 SC 4 WG 12 is revising ISO 15900:2009 “Determination of particle size distribution -- Differential electrical mobility analysis for aerosol particles”. The current draft contains parameters recommended by EMRP ENV02 and a note saying “The relevant documents, EMRP ENV02 WP1 D1.1.1 and its Supplement can be found at https://www.ptb.de/emrp/partemission-publications.html”.

CEN TC 264 WG 32 is working in a Technical Specification “Ambient air - Determination of the particle size spectra of atmospheric aerosol using a Mobility Particle Size Spectrometer (MPSS)”, and this is expected to contain similar specifications.

Both documents are still at the draft stage at the end of the SIP project.

Impact

The main dissemination activities were, firstly, liaison with PMP members and participation in PMP meetings, and contributions to PMP documents, and, secondly, participation in CEN TC264 WG32 and ISO TC24 SC4 WG12 standardisation working group meetings and activities, and contribution to CEN and ISO standards. These were supplemented by presentations at other meetings and conferences, as described above.

The impact of the project can be seen to be the result of the extensive direct participation in PMP, CEN and ISO meetings, with provisional incorporation of EMRP ENV02 findings into the relevant texts, together with broader dissemination of EMRP ENV02 findings through conference presentations and the organisation of measurement comparisons, as described in the previous section. The PMP meetings were of the Informal Working Group of the PMP, whose chair is Caro Hosier, the primary supporter of this project.

The activities of the project will lead to short-term impact in the form of improved and up-to-date PMP-related regulations and CEN/ISO standards.

Arising from this, the longer term impacts of the project will be:

- Optimised activities by car manufacturers and inspection authorities with respect to accurate and reproducible determination of aerosol emissions, through improved documents and the uptake of traceable calibration services;
- Precisely tailored and thus more cost-effective developments of engine operating conditions and exhaust treatment, because the emissions can be measured more accurately, through improved documents and the uptake of traceable calibration services, thereby reducing the safety margins needed to fulfil the emission regulations;
- A reduction in the substantial adverse health effects that are caused by airborne particles, through mitigation measures that have been scientifically justified and validated in ways that would not have been possible without the project.

Project start date and duration:	1 June 2015, 36 months	
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