



## Ensuring the accuracy of breath analysers used to enforce drink driving regulations

Worldwide 1.25 million road deaths occur per year due to road traffic accidents and the EC has estimated that 25% of these involve at least one drunk-driver. For this reason, countries have legal limits that stipulate the maximum concentration of ethanol in the blood of drivers when behind the wheel of a motor vehicle. Whilst many drivers obey drink-driving regulations voluntarily, some only do so due to the threat of being detected.

### Europe's National Measurement Institutes working together

The European Metrology Programme for Innovation and Research (EMPIR) has been developed as part of Horizon 2020, the EU Framework Programme for Research and Innovation. EMPIR funding is drawn from 28 participating EURAMET member states to support collaborative research between Measurement Institutes, academia and industry both within and outside Europe to address key metrology challenges and ensure that measurement science meets the future.

# Challenge

Since 1938, when the first instrument for detecting alcohol in breath was developed, the 'breathalyser' has become increasingly sophisticated. These instruments determine if a person has potentially consumed alcohol by measuring the concentration of ethanol in air exhaled from their lungs. They are now used by law enforcement agencies throughout the world to detect offenders and, to do this effectively, it is essential they are accurately calibrated in line with national and international standards.

Regardless of the country, all legal requirements stipulate the use of certified reference materials (CRMs) to perform such calibrations. Whilst CRMs composed of gases of ethanol-in-air are routinely used the International Legal Metrology Organisation's (OIML) recommendation R126 stipulates that the most appropriate for breath analysers are those that mimic the moisture of human breath, such as water containing precisely defined levels of ethanol. However, this requires large quantities of 'ethanol-in water' CRMs which are difficult to transport over large distances – especially through customs at national borders.

At the beginning of 2017 there were only two metrology institutes in Europe that could produce this material to the metrological level required for breath analyser type approval and calibration, BAM in Germany and LNE in France.

# Solution

During the ALCOREF project BAM and LNE transferred their knowledge in ethanol-in-water CRM production to eight metrological institutes across Europe, including TUBITAK UME, the National Metrology Institute (NMI) of Turkey. CRMs were prepared by spiking a defined mass of high purity ethanol into water using metrologically sound weighing and bottling procedures and techniques.

TUBITAK UME developed Quantitative Nuclear Magnetic Resonance Spectrometry methods to directly assess the purity of the ethanol used and applied a gravimetric approach to produce the materials, which were then assessed using Gas Chromatography Flame Ionisation Detection.

Comparability of the methodologies developed by project partners was demonstrated in three interlaboratory comparisons, including EURAMET comparisons EURAMET.QM-S13 and EURAMET.QM-S14. These confirmed the ability of the participants to make validated CRMs linked to the SI. The new methods were then documented as Standard Operation Procedures and incorporated into each partner's Quality System to ensure consistent performance over the long term.

# Impact

Zer Elektronik, based in Turkey, has been providing leading-edge instrumentation since 1945, introducing the first amplifier in the region in 1946. The company has continued its approach to innovation ever since.

TUBITAK used the CRMs they produced in the project to ratify the performance of a breath analyser that Zer Elektronik was developing. The company acknowledges that the certification of performance of the new instrument by a leading NMI will give confidence in its use to their customers, which include the law enforcement agencies to which Zer Elektronik already supplies items to - such as sirens and light-bars for police vehicles. A local source for ethanol-in-water CRMs has been a great advantage to the company in maintaining its position of developing in-house products - allowing it to keep prices for its goods low, enabling the shipping of competitively priced products to Europe and beyond.

As well as confirming the accuracy of the new meter the tests performed by TUBITAK, using six different certified ethanol solutions, can be utilized to satisfy some of the requirements for compliance with the USA's Department of Transport's Highway Safety Programs; 'Model specifications for Devices to Measure Breath Alcohol' – meaning the device has also been considered for sale in America.

The new materials developed in the project will allow more countries in Europe to better calibrate breath analysers, helping to enforce drink-driving regulations, and potentially saving hundreds of lives each year.

## Extending capability for forensic alcohol reference materials

In the project LNE and BAM transferred experience in developing ethanol-in-water CRMs to metrology institutes CEM (Spain), DMDM (Serbia), GUM (Poland), IMBiH (Bosnia and Herzegovina), INM-RO (Romania), EXHM (Greece), FTMC (Lithuania) and TUBITAK UME (Turkey).

Techniques transferred included gas chromatography with flame ionisation detection or mass spectroscopy. Metrologically sound weighing and bottling procedures suitable to produce the CRMs as required by end-users were also established.

All partners can now prepare ethanol-in-water CRMs with assigned ethanol mass fraction values in aqueous media from 0.1 mg/g to 7 mg/g with a 95 % level of confidence relative uncertainty of  $\pm 2$  % or less.

Quality assurance systems have been improved or established according to ISO 17034 and ISO Guides 30 to 35 which allow the reproducible production of the certified materials.

New measurement capabilities now exist in Europe for producing ethanol-in-water CRMs – essential for calibration of breath analysers, the accuracy of which is essential to reduce alcohol-related traffic accidents.



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[www.euramet.org/project-16RPT02](http://www.euramet.org/project-16RPT02)

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