Uncertainty of analysis, test and measurement results. Where are we now?

Summary of the talk presented by M. PRIEL (LNE) at CECALAIT's AGM 2004

The standard ISO / CEI 17025 implicates that laboratories must have a procedure for the estimation of uncertainty of test and measurement results.
The degree of precision of the chosen procedure will depend on the requirements of the method and the client, and the spread of the limits with a declaration of conformity in mind.
The standard also indicates that the uncertainty must be declared in the following cases: if the client asks, if it affects the conformity due to the specification limits (interpretation of results), or when it is important for the validity or the application of the test results.

For laboratories that follow a method indicating the values of the main sources of uncertainty, the demands can be considered as being satisfied. Otherwise, the laboratory must identify all the components of uncertainty in order to give an estimation as exact as possible. A "reasonable" approach can be carried out using the performance values of the method (from work on standardisation or validation).

In order to indicate its position, the COFRAC established a note on the subject in October 2004, of which the main points are as follows:

The demands described in the document EA (4/02) remain unchanged for calibration laboratories. However, for testing laboratories, a new guide, EA (4/16), developing the specificity of the evaluation of uncertainty in such laboratories, has been published.
This publication foresees, for each analysis or test method, an identification of factors susceptible to influence the results (and the justification of not taking them into account, if need be), as well as a demonstration of their control. This information, associated with all other details (accuracy, inter-laboratory studies, control cards), will serve as a basis for the estimation of uncertainty.

For laboratories, this procedure may seem complicated at a first glance. However, evaluating uncertainty is firstly, the good understanding of the test process, and then the usage of all the information available to the laboratory. Finally, it is a way of controlling the test process and dialoguing with clients.

Two approaches are possible:

- An intra-laboratory approach

In this case, the test process can be modelized. The procedure described in the "GUM" (Guide to the expression of uncertainty of measurements) can be applied in 4 stages:
① Definition of the measurand, analysis of the mathematical process and determination of the mathematical model.
② Estimation of standard uncertainties of the initial magnitudes of the model
③ Estimation of the composite uncertainty (application of a principle of propagation)
④ Expression of the final result as a broadened uncertainty: $U(y) = k \times u_c(y)$
In cases where it is impossible to modelize the procedure, the laboratory should, in order to be able to estimate uncertainty, use all available information: intra-laboratory repeatability and reproducibility, effect of influencing factors and details on precision.

- An inter-laboratory approach

In this case, the following can be used:

- The results of accuracy (repeatability and reproducibility), obtained within the context of the determination of the performance of a method (according to ISO 5725).
- The laboratory's performance characteristics, obtained during participation in proficiency testing (organisation according to ISO 43-1 and statistical treatment according to ISO / FDIS 13528)

Some available references …

- **EA-4/16 :**
Guidelines for the expression of uncertainty of quantitative test results in proficiency testing (in French on-line at www.lne.fr)

- **ISO / TS 21748 :**
Guide to the use of repeatability and trueness estimates in measurement uncertainty estimation.

-Guide EURACHEM / CITAC :
Quantifying uncertainty of analytical measurement
(available on-line in French at www.lne.fr