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Nordic Innovation Centre

# POSITION PAPER

## **NORDTEST VIEWS ON UNCERTAINTY IN METROLOGY AND TESTING**

Position paper 3  
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This paper is a contribution to European discussion regarding uncertainty and comparative testing as related to the European conformity assessment procedure and to the reciprocal recognition of test results within the fields of measuring, testing and chemical analysis. It defines the development needs and warns that a non-coordinated European effort will give rise to heavy expenditure.

## 1. Introduction

Traditionally the laboratories have been divided into metrological laboratories, laboratories for testing, and analytical laboratories. Their working methods and their development have been different primarily due to the different needs of their customers. In connection with the conformity assessment activity it seems advantageous to evaluate laboratories and their measurement and testing capabilities on an equal European basis.

The subject "uncertainty in measurement" has primarily been related to the metrological field, which operates internationally. The concept of uncertainty as a quantifiable attribute is relatively new in measurement and testing, although error analyses have long been an integral part of measurement science or metrology.

Today a metrological laboratory is characterized by its "measurement capability", a quality which is closely connected to the uncertainty concept through an uncertainty budget. In calibration certificates the result of the measurements should be given together with the overall uncertainty. Correspondingly testing and analytical laboratories should be characterized by their "testing capability" and "analysis capability".

## 2. Conditions affecting the measuring, testing and analysis capability

The following conditions certainly affect the measuring, testing and analytical capabilities:

- The ability to measure, to test or to analyse must be derived from the need of the customers
- Methods have been produced for various purposes, and they have various levels of accuracy
- Some methods are intended as reference methods, which means that they are used with a high level of accuracy and are traceable to international standards. Other methods are intended as control or check methods. Here relative measurements can be sufficient. Often the ease of use and the time factor are more important than the accuracy.

One has to distinguish between different categories of methods, and it is important that methods are used for their intended purpose. One should operate with reasonable and realistic accuracy levels and pragmatic advice to laboratories on how to define their measurement, testing and analytical capability. Often one has to look at several elements, including sampling, before requiring a certain accuracy. E.g. sampling of inhomogeneous materials is difficult, and the needed accuracy in testing and analyses should reflect that problem

Testing, measurements and analyses should be performed according to international standards if possible. Within areas where this is not possible, one must try to validate the methods to an extent which is deemed necessary and make reference to known and accepted references whenever reasonable.

## 3. Metrology

When reporting measurements on fundamental units and their primary derivatives, the measurements are characterized by their uncertainty and are traceable to international standards.

Verification of a measuring instrument within the field of legal metrology has been performed according to methods developed by OIML. The uncertainty has not always been known. The laboratories have started to evaluate, validate and verify new methods including calculation of uncertainties to be able to give reliable results.

Testing of measuring instruments within the field of legal metrology has been performed according to OIML evaluated methods. Individual tests and measurements are often carried out using equipment which has been calibrated traceable to international standards. One has to distinguish between traceable measurements and testing of products. It is not necessary to distinguish between measurements of fundamental and legal nature.

## 4. Technical testing and chemical analysis

Within technical testing and chemical analyses there has not been the same tradition to give uncertainties in connection with a result or to state testing and analysis capability.

**Technical testing:**

Within technical testing the methods can be divided into:

- methods where the results are related to fundamental units or their derivatives,
- methods for testing of products,
- non destructive testing
- simulative test methods, which are often used as production control methods.

As regards methods the results of which are related to fundamental units or their derivatives, it is possible to state a measuring capability and to present the result together with an uncertainty. For product testing, non destructive testing and simulative testing it can even be misleading to talk about uncertainty.

Within product testing, the laboratories' testing capability can be mainly given through comparative testing and their competence area.

#### Chemical analyses:

Laboratories within the chemical analytical field are expected to state their analysis capability for wet-chemical methods and within those fields where certified reference materials exist.

Until certified reference materials are available and until solvents and other consumables can be delivered in a certified way, uncertainty and analysis capability must be related to non-certified reference materials "approved" to be of good quality. In this interim period the analysis capability of chemical analytical laboratories must be based upon comparative testing.

#### 5. Economy

It is necessary to realize that it is costly and time consuming for the laboratories to make a change from the present situation to the point where they can state measurement, testing and analysis capability. If the process takes place in a non controlled way, and every organization or country develops their internal rules in their own way, a lot of money and resources in will be wasted in Europe. The evolution must occur in a co-ordinated way due to the need of a harmonized approach in Europe.

Is it meaningful to arrange national comparative tests and to give uncertainty in a national way when the products are exported?

Costs are increasing in an exponential way when one asks for better accuracy. Therefore we must follow the needs of the customer since it is he who has to pay for the service.

#### 6. Future evaluation.

It is time consuming to evaluate the laboratories' measurement, testing or analysis capability, and it will take some time before the laboratories' capability is determined in a reliable way.

It is necessary to agree on the following steps as a basis for future progress:

- Evaluation of common principles and conditions in describing measurements and stating uncertainties for metrological laboratories
- Evaluation of common principles and conditions in describing measurements and stating uncertainties for testing laboratories, where results are based upon fundamental units and their derivatives
- Evaluation of common principles and conditions regarding non destructive testing
- Discussion of the necessity for traceable calibration of test conditions (e.g. temperature and humidity) in product testing. This is of less importance if comparative tests are consistent
- Evaluation of common principles stating uncertainties for chemical laboratories including uncertainties in the sampling procedure
- Production of certified reference materials giving priority to the needs of the customer.



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## NORDTEST

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