RESEARCH ARTICLE OPEN ACCESS

Consideration of the Sampling in the Statement of Conformity

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ABSTRACT
The factors of influence of the processes of measurement introduce inevitably a zone of uncertainty of measurement more at least big according to the control of the process. This margin questions our declaration of conformity. The object of the study is to introduce a new method allowing to limit the uncertainty of measurement basing itself on the customer risks and the supplier, quality levels acceptable and thrown rejected, and by the size of the sample.
Keywords: uncertainty of measurement, the customer risks, the supplier risks, the sampling

I. Introduction

It is illusory to want to control a product and to pronounce on its conformity compared with a specification or a standard, if the process of measurement is unreliable. Of more a moderate value is not thus an exact or certain value: it arises from result presenting a certain dispersal, or variation. This result of measure can be altered by the **M**aterial or its physico-chemical properties, the **M**iddle or the environment in which is made the measure, the **M**eans or the equipment of surveillance and measure, the **M**ethod or the procedure of measure and the **M**an or the staff responsible for the measure. The non-mastery of these factors or a misunderstanding of the corrections to be applied introduces inevitably the increase of the zone of doubt on the result of measure and thus a reduction of the zone of conformity (figure 1) .

The consideration of this zone of doubt, that is the uncertainty of measure, in the declaration of conformity is the object of several works. It is a question of defining, is the zone of conformity [1], or a coefficient of capability [2, 3].

What interests the customer, it is to know the risk that the object is declared corresponding while he is not! Especially for the big construction sites, or for the products at risk the loss of income of which is important.

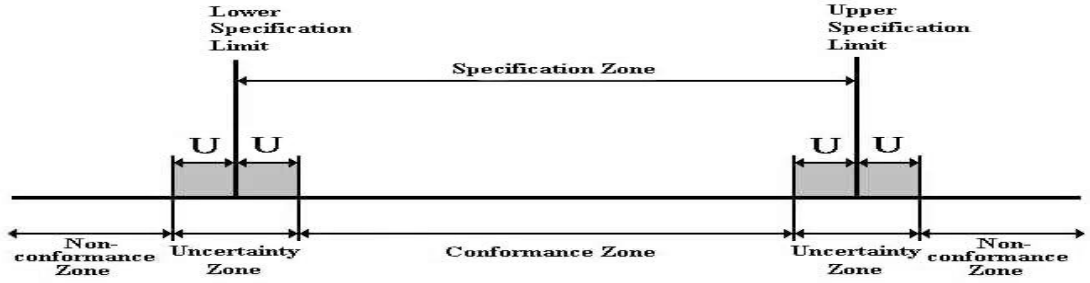

Figure 1: Statement of conformity

II. The 5 M of a measurement process

1. Material

These include not only the measurement result depends:

- Of the coefficient of expansion, the elastic deformation and the dimensional stability of the material (for the dimensional measures),
- Of the density, the compressibility and the viscosity of the fluid (for the volume measurement of pressure and the debits),
- the temperature gradient, the thermal inertia and exchange (for temperature measurement of the humidity, the calorific value),
- The gradient of concentration and purity of fluids (for measurement of density of concentration, polarity, ...),
- geometrical defects , micro and macrographic (for the characterization of materials),
- Of the density of materials (for the measure of mass, density, ...),

- Of the stability of the atomic frequency and the spectral purity of the source radio frequency (for the time measure),
- the stability of the radius (for the measurement of light, reflection, opacity, ...),
- Of the resistivity, the dimensions and the type of material (for the electric measures)

2. Middle

In the general case, attention should be paid to the temperature, humidity, air pressure, dust, electromagnetic disturbances, radiation, to the electrical supply, As well as in the levels of noise and vibration, according to the tests to be made.

Note : According to the standards for example ISO/CEI 17025:2005 [6] testing should be stopped when the environmental conditions have the effect of mortgaging the test results.

3.* Mean*

An indication by a sensor, a value read from a comparison can only be considered if the same instrument has previously been compared to a known reference: the standard and even that is not enough! You must use this equipment in conditions acceptable to himself and measure the factors that influence the result, for example:

- the accuracy (in case no correction is taken, the result(profit) is biased and a component of uncertainty is imperative),
- fidelity, it is an uncorrectable random error, but may decrease by multiplying the number of measures,
- the exenteration of load (when this error is important for balances such as the positioning of the product on the load receiving a major effect),
- The mobility (for example; the result of the method of thresholds for the measure of the weight is influenced by the error of mobility of the used balance),
- The charging time can cause creep effect (to remedy this effect, usually for balances example, allowed under load for 4 to 8 hours, with a weight of 50% to 80% of the maximum load),
- the sensitivity (variation when input causes no variation of output, the result is influenced, for example for dosers the mass, volumetric potentiometric, ...)
- the homogeneity and stability of a mid-comparison (for example, for ovens calibration providers do not verify systematically these two parameters, while space and time has an effect on the conditioning of the specimen),
- The time of answer (for the automatic measures of masses, strengths, speed, debits, ...),
- The technology (manual, semi-automatic or automatic: today thanks to the lower cost of sensors and advances in computer technology, you can use intelligent sensors to detect anomalies in the measurements).
- The capability; in the sense of the statistics, the capability of a measuring instrument or a process of measurement is the report enter the performance asked on the real performance. In the case of control of a product, the requested performance is defined by the tolerance (t) of the measured product and the actual performance is defined by the expanded uncertainty of the measurement process. In the case of the declaration of conformity of a product, according to standard NF E 02-204 [2], in the absence of contract customer / supplier process capability measurement (t / U) must be superior or equal to 8.

Measurements made by a measuring instrument involve not only to verify, following periodicities determined, capability and conformity of its metrological characteristics (accuracy), but also to proceed to a follow-up of its performances in the time (control charts) and also to optimize this time.

4. The method used

Making we call direct, or indirect methods by inversion, substitution, or turning?

Taking into consideration is the number of measurements or performing on methods of repeatability and reproducibility?

Participating on programs interlaboratory comparisons or testing aptitude?

Comparing on the results to those of other organizations accredited or certified?

Using one of the standard methods?

Validating the methods we developed internally?

Using it regularly certified reference materials?

Performing tests on reiterated using identical or different methods?

Performing one retest of preserved objects?

Performing on correlations results for different characteristics of an object?

A purpose of ensuring the quality of the results and approve the methods are applied, there must be procedures quality control to monitor the validity of the tests undertaken. The resulting data should be recorded so that trends are detectable and, where practicable, statistical techniques are to be applied to the examination results.

In particular cases (difficulty of using standard methods or the inexistence of a standardized method), methods developed by the laboratory or methods adopted by the laboratory may also be used if they suit its intended use and they have been validated.

5. Man (Workforce)

Personnel performing measurements in a laboratory must be qualified to the measure, competent and qualified. The qualification is based not only on the level of education the formation, experience, but also on tests of comparisons to qualified people through measurable criteria.

This qualification begins as soon the preparation of the samples to the establishment and interpretation of results (sometimes) by the way, obviously, for testing, taking care to properly use and maintain the equipment.

Errors due to handling are numerous:

-interpolation of reading (for analog instruments, dial indicator for example)

-

pressure measurement (e.g. for measurement with a Vernier caliper

measurement pressure must be between 4 and 10 N),

- Error of parallax (when measuring the volume),

The guarantor by excellence of the result is a rigorous, constant, careful, meticulous, applied and relevant operator as for the analysis of the results.

III. Risk of the customer and supplier

The doubt comes from 5M, certainly, but also from sampling [the levy Unit (s) to be tested in the Lot to control] introduces a significant part (if it is obtained by sampling.

not essential) of the total error, especially when you have to give opinions and interpretations and that we should judge the lot from the results obtained on a sample.

From the supplier : Because of this uncertainty, the control by sampling is vitiated by the supplier risk (α), the acceptable quality level (AQL) and the sample size (n), (Figure 2);

$$z \cdot \sigma = u_{NQA} \cdot \sigma - u_{\alpha} \cdot \sigma / \sqrt{n} \quad (1)$$

As the measurement uncertainty (USF) is less than the quantity (z*σ) the risk to declared non-compliant and minimal. The supplier must confirm the condition:

$$U_{SF} \leq u_{NQA} \cdot \sigma - u_{\alpha} \cdot \sigma / \sqrt{n} \quad (2)$$

with :

- ✓ n : the sample size,
- ✓ Uα : variable associated with reduced risk α,
- ✓ U_{NQA} : Reduced variable associated in NQA,
- ✓ z : The coefficient of GAUSS of the limit of acceptance.
- ✓ U_{SF} : Uncertainty of maximal measurement, the control made by the supplier,

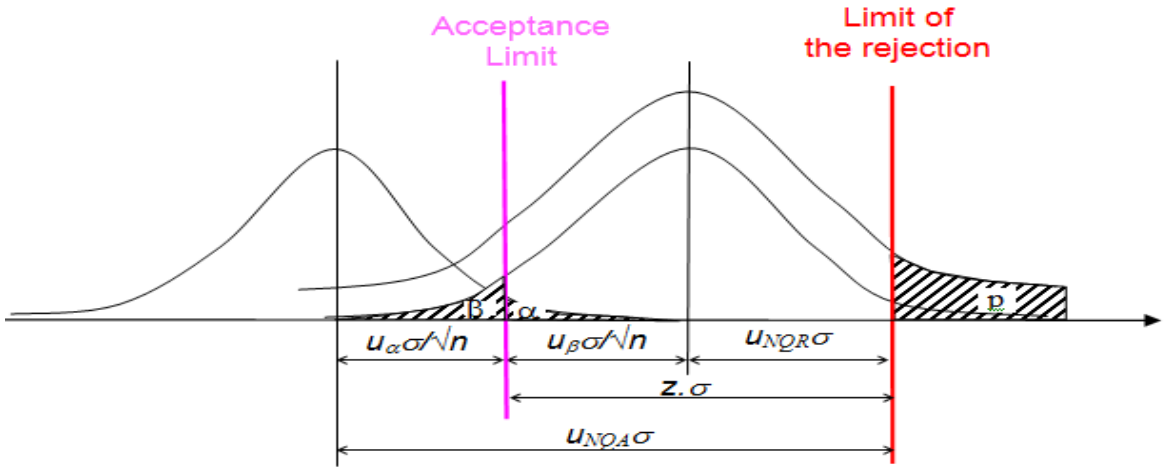

Figure 2: Guardbanding

From the customer: The control is vitiated by the customer risk (β), Of the level of rejected quality (NQR) And of the size of the sample (n). During the control of reception, the customer has to verify the condition :

$$U_{SC} \leq u_{NQR} \cdot \sigma - u_{\beta} \cdot \sigma / \sqrt{n} \quad (3)$$

with :

- U_{β} : Reduced variable associated with the risk β,
- U_{NQR} : Reduced variable associated in NQR,
- σ : The estimated standard deviation is n<30 Samples, we have :

$$\sigma = \sqrt{\frac{\sum (x_i - \bar{x})^2}{n-1}} \quad (4)$$

- p : The probability of non- compliant in the lot.
- U_{SC} : Uncertainty of maximal measurement, the control made by the customer, obtained by sampling.

IV. Application

consider an example of indirect tensile tests of stiffness modulus, according to standard NF EN 12697-26:2004 [5],tests on cylindrical specimens 100mm in diameter, with thickness of 53mm and 2451kg / m³ density, were carried out under the conditions listed in Table 1 :

Horizontal deformation under	5 ± 2 µm
Frequency	10 Hz
Number of pulses	10
The pulse repetition period	3 ± 0,1 s
Rise Time in load	124± 4ms
Poisson's ratio	0,35

Table1. Conditions of the test

was obtained a stiffness modulus for main E*=6696 MPa, with an estimated standard deviation σ=297MPa And a expanded uncertainty intralaboratoire U = ± 849 MPa. The uncertainty was calculated by the laboratory (provider of the essay) according to an analytical method based on the GUM[4].

The requirements defined between the customer and the supplier listed in Table 2:

Lower tolerance (TI)	6000 MPa
Level of acceptable quality (NQA)	0,5 %
Supplier risk(α)	2,5 %
Rejected quality level (NQR)	1%
Customer risk (b)	5 %

Table 2

The supplier has taken ten cylindrical specimens (n = 10) for the control.
Besides, because of the uncertainty, the risk of declaring the non- compliant section is obtained by (figure 3) :

$$R = \int_{5847}^{6000} \frac{1}{\sigma\sqrt{2.\pi}} \cdot e^{-\frac{1}{2}\left(\frac{E_i^* - \overline{E^*}}{\sigma}\right)^2} dE^* = 0{,}74\% \quad (5)$$

With $\overline{E^*} = \frac{\sum E_i^*}{10}$ The average of the stiffness modulus is and σ the estimated standard deviation.
Since R<α (Supplier risk (2,5%)), The section will be declared corresponding with a risk of 0,74% . However, the uncertainty calculated by the supplier is superior to that calculated from the condition (2), (since $U_{SF} \leq 580$ MPa). With this uncertainty (E*min>TI With an gain of 2,31%), There is no risk of declaring the non- compliant section. Consequently, the supplier has to improve his process of measurement.

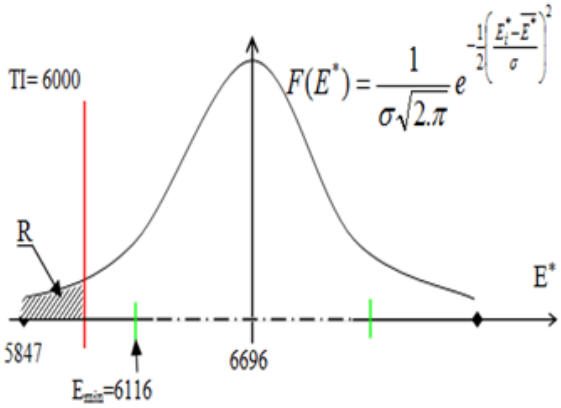

Figure 3 : Normal distribution of the test module

V. Conclusion

In this study we presented in the first part of the 5 factors of influence of a measurement process; which are **M**aterial, **M**iddle, **M***ean*, **M**ethod and **M**an (Workforce) .

In the second part of this subject, we have, modestly, the effect of the sampling on the declaration of conformity of a product We showed, whether it is for the final control made by the supplier or the control of reception made by the customer, it is imperative to verify, respectively the conditions of sampling U_{SF} and U_{SC} . This method of estimation of the uncertainty from the risks (α and β), of NQA and of NQR The conformity is introduced for the first time to declare and to make a decision without risk.

Besides, from the example treated, we found that the fact that the uncertainty of measure intralaboratory (GUM) Is superior to that obtained from the condition of sampling, creating a risk of 0,74% Who will be taken by the customer.

However, for our level we have no results of comparisons interlaboratories. On the other hand, if we led this study with the uncertainty obtained from the comparisons intrelaboratoires published in the NF standard IN 12697-26, the risk will more be big because in the general case the results of the synthetic methods, based on the calculations of repeatability and reproducibility, are increased.

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