Measurements at Catas

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A recent scientific news is our starting point to talk about an aspect of the laboratory activity that usually remains embedded for our customers but is fundamental for the quality of the results of the tests we do: **the traceability of the laboratory measurements**. A measure is "traceable" when it can be related to a reference through a documented unbroken chain of calibrations as indicated by the International Metrology Vocabulary or VIM. In a few months, the current standard used as the primary reference of the kilogram will be retired and a new definition will be used (see box).

Speaking of measurements and measurement systems, a first reflection should be dedicated to the effect of the approximations deriving from the unit of measurement adopted. We know that the main activity of Catas are the tests on products and materials that are sent to us every day: these tests are carried out according to what is indicated by the reference standards, which specify the quantities to be considered, the measurement methods/instruments and the "tolerances" admitted. In the case of European (EN) and international (ISO) standards, the reference metric system is the international system (SI). In the case, for example, of American standards (ANSI BIFMA, ASTM), the measurement system is the US customary one, which involves the use of inches, feet, ounces and degrees Fahrenheit: for the execution of tests according to these rules our laboratory must therefore inevitably introduce approximations in the conversion between units of measurement. Fortunately, another very important reference market for our customers, China, has adopted the international metric system and is working with conviction in ISO for the harmonization of international standards with European ones!

The International Metric System identifies 7 fundamental physical quantities on the basis of which the

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The new scientific definition of the kilogram

*The **kilogram** is a unit of measurement that until today has been defined with a physical object: a **cylinder of platinum and iridium** preserved at the BIPM (Bureau International des Poids et Mesures) of Sèvres (France). But the weight sample, although preserved with the utmost care, is however subject to variations due to dust, wear and other elements, so much that from 1889 to today its mass seems to have varied about 50 micrograms.*
Since the unit of measure must be stable, for a long time now it has been decided to introduce a reference system that can do without a material object, as is now done for almost all the other units of measurement.
*If we take the **meter**, for example, which was once determined by the distance between two parallel segments drawn on a face of a platinum-iridium bar, since 1983 it is defined by the distance that light travels in the vacuum in a time equal to almost 1 three hundred thousandth of a second. The platinum/iridium bar is now only a piece of history, to be kept in a museum.*
*Likewise, it has recently been established that the kilogram, starting from 20 May 2019, will be redefined by abandoning the platinum-iridium cylinder and adopting a new definition based on an atomic constant, in particular the **Planck constant**. The new definition of kilogram, however, is rather complex, and its explanation will certainly be a challenge for secondary school teachers of Physics... In a very, very approximate way, the kilogram becomes the mass counterbalanced by a certain amount of current, where Planck's constant comes into play.*

derived physical quantities are defined: it is interesting to note that here in Catas we make measurements that concern all the 7 fundamental quantities (see box). An intrinsic component of the uncertainty of the measurements carried out by the laboratory is the one deriving from the calibration of our instrumentation, where by this term we mean the operation which establishes a relation between the quantity values provided by measurement standards with known uncertainties and corresponding indications of the instrument under examination with associated measurement uncertainties. The calibration of the laboratory measuring instruments can be performed internally or be entrusted to an external calibration laboratory.
In particular, all the equipment whose calibration uncertainties can be calculated and have a direct and significant influence on the final measurement uncertainty (scales, gauges, probe indicators, thermometers, etc.) are calibrated by accredited calibration laboratories (LAT).
The equipment that cannot be calibrated by these laboratories, are calibrated internally according to specific calibration procedures based on external reference documentation and using reference instruments, which in turn are calibrated by an accredited calibration laboratory. For example, this is the case of special or "ad hoc" equipment made for our needs, such as the Chair Measurement Device - ISO CMD and SCMD for the measurement of office and school chairs.
Finally, the instruments whose calibration uncertainties do not have a significant effect on the measurement uncertainty (eg a stopwatch to measure the application time of the substances for the edges heat resistance test, a load cell for the application of a force in the test methods for chairs and tables, ...) are calibrated internally by the lab with conveniently simplified procedures.
Some data:

- Equipment used by the laboratory, subject to periodic calibration operations: almost 600;
- Reference equipment and materials, used only to calibrate other equipment: more than 100.
- There are also 460 other equipment and plants that do not carry out direct measurements (for example anthropomorphic robots), but which are still subject to periodic maintenance by Catas technicians and/

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The seven fundamental physical quantities at Catas

- *Length: dimensional checks*
- *Mass: application of loads*
- *Time: duration of phenomena, for example in reaction to fire tests*
- *Temperature: exposure to particular atmospheric conditions*
- *Electricity: checks on electrified furniture*
- *Quantity of substance: quantitative chemical analyzes on paints and resins*
- *Light intensity: characteristics of reflectance of the surfaces*

or external suppliers.

More than one thousand instruments, whose management involves more or less complex (and expensive) activities that are carried out with a scheduled frequency.

For example, all laboratory scales and gauges are checked by a LAT (accredited calibration laboratory) on an annual basis. Furthermore, the laboratory performs intermediate checks at close intervals or continuously (every time the instrument is used) to guarantee the constant reliability of the data.

The purpose of this activity is obviously to guarantee the accuracy of our measures, a necessary but not sufficient condition to ensure the good quality of our test results. The effort made by the laboratory (in terms of time, training of human resources, money, ...) allows our customers, on the one hand, **to know the uncertainty** associated with our measures and on the other to obtain results associated with "reasonably low" uncertainties.

This issue, unfortunately, until today has been little or no interest for our customers, but times change and with the new edition of the UNI EN ISO 17025 standard for the accreditation of test laboratories, already published in January 2018 and that will be soon adopted by our laboratory, **an important novelty arrives**.

In the case of **conformity assessments** (i.e. when there is a limit to be met and the test has the purpose of verifying whether the product/material meets this limit), the contribution of measurement uncertainty to the result of the test may in fact change the judgment of compliance, from positive to negative or vice versa.

Therefore, in this situation, our customer can and **must first agree** with the laboratory how to take into account the contribution of the laboratory measurement uncertainty for the purpose of assessing the conformity of its product. It is clear that this new feature of the standard is important especially in cases where the result is close to the limit. More details coming with the next newsletter .....

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