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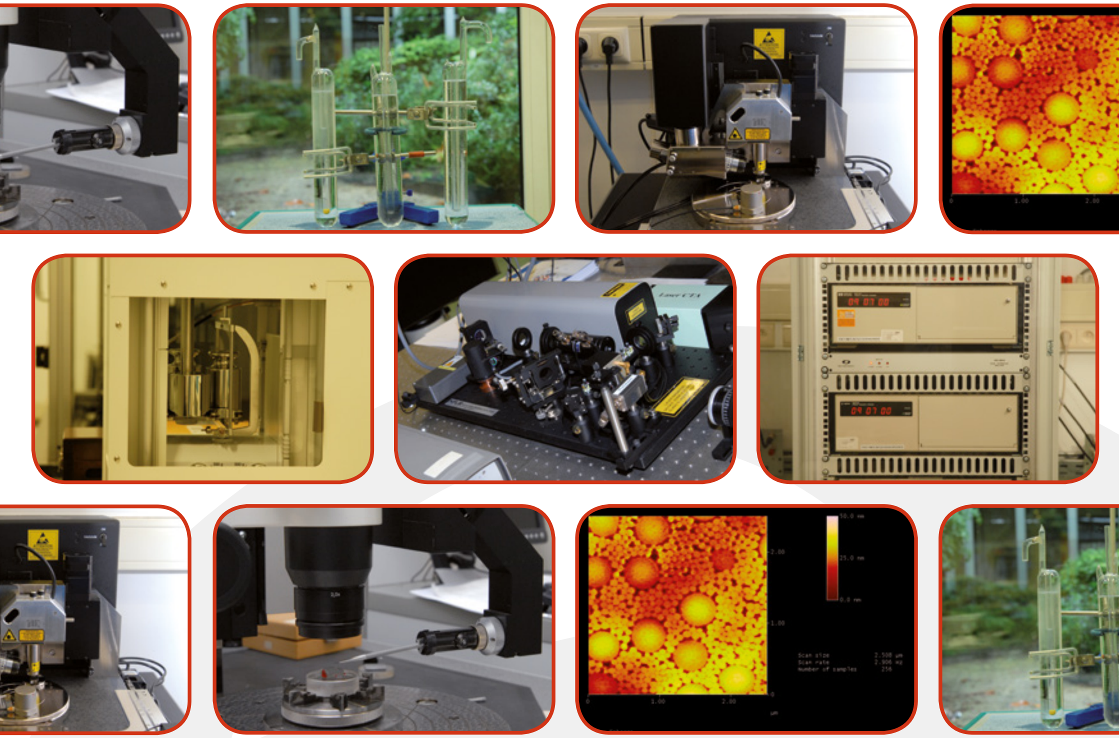

National Standards

economie
FPS Economy, S.M.E.s, Self-employed and Energy

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The mission of the FPS Economy, SMEs, Self-Employed and Energy is to create the conditions for a competitive, sustainable and balanced functioning of the goods and services market in Belgium. Within this scope, the General Directorate Quality and Safety issued this publication aiming at:

- ensuring the quality of measurements in Belgium;
- supporting innovation;
- spreading metrological knowledge.

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"Creating the conditions for a competitive, sustainable and balanced operation of the goods and services market in Belgium."

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"Creating the conditions for a competitive, sustainable and balanced operation of the goods and services market in Belgium."

1. The role of the SPF Economy

The SPF Economy, SMEs, Self-Employed and Energy helps production and trade and raises the competitiveness of the Belgian companies by putting forward the necessary technical infrastructure and the scientific skills to provide high precision metrology standards and services which are consistent with those of other countries.

The National Standards Service supports the Belgian economic and scientific stakeholders by:

- **ensuring quality** by providing a direct connection between precision equipment or the transfer standards of the customer and the national standards through calibration provided to industries and laboratories. Hence the traceability to IS (International System of units) is guaranteed and consequently the international equivalence of the measurements used in the manufacturing processes.

- **supporting innovation** by the development and the improvement of suitable standards through research programmes. Companies using new technologies are provided with precise calibration of their instruments in order to ensure the quality of their products and the compatibility of the parts that are jointly manufactured.

- **disseminating metrological knowledge** through experts answering specific questions or taking part in more in-depth consultancy projects for companies developing and installing new measurement setup.

The actions put in place to ensure these services in an optimal way include:

- a special focus on the **nanometrology** through investments and innovative development programmes;
- involvement in **European research programmes** in metrology (EMPIR and Euramet);
- **technical support** to the Belgian organizations Belac and Belmet;
- participation in activities and **international comparisons** of Euramet and BIPM.

2. Ensuring Quality: Traceable Calibrations

The calibration of measurement instruments is the only way to know for sure the correctness, the precision and the validity of measurement. Used as a tool to ensure quality, the regular calibration of the equipment helps to minimize the cost related to errors due to inaccuracies or erroneous measurements. Regular calibration thus leads to real savings.

The calibration services proposed by the FPS Economy are designed so that users and manufacturers of measurement instruments can perform the best quality measurements. Most services of the National Standards Service are unique in Belgium in three ways:

1. **availability**: the latest technological improvements are quickly implemented. Some examples: JVS (Josephson Voltage Standard), traceability of the AFM (Atomic Forces Microscope), new definition of the Kelvin;
2. **quality**: lowest measurement uncertainties;
3. **international recognition**: our published calibration and measurement capabilities (CMC) are guaranteed and recognized by all the countries that are signatory of the Meter Convention (BIPM), through a system of international intercomparisons.

Our laboratories carry out very high precision measurements and calibrations in the following fields:

- nanometrology;
- dimensional metrology;
- masses;
- electrical measurements;
- time and frequency;
- thermometry;
- volumes.

Complementary services are offered in Belgium by several accredited laboratories.

3. BELMET

BELMET is a network of research institutes and public or private laboratories with an infrastructure that the National Standards Service does not have. It was set up by the royal decree of 18 July 2008, setting up a network of metrological laboratories. These institutes and laboratories developed an expertise in specific fields and have an excellent reputation. On the basis of the royal decree of 18 July 2008, they can be recognized, under certain conditions, as principal laboratories for defined measurements units. Their tasks include, among others, setting up reference standards and carrying out traceable calibrations for these units. One of the main conditions for this recognition is an accreditation based on the international standard ISO/IEC 17025.

The Laboratory for Nuclear Calibrations (LNK) of the Belgian Nuclear Research Center (SCK-CEN) obtained this BELMET recognition for the implementation and the management of national standards and for ensuring the traceability of measurements in the field of ionizing radiation, subfield dosimetry, namely the Gray and Sievert units and neutron metrology.

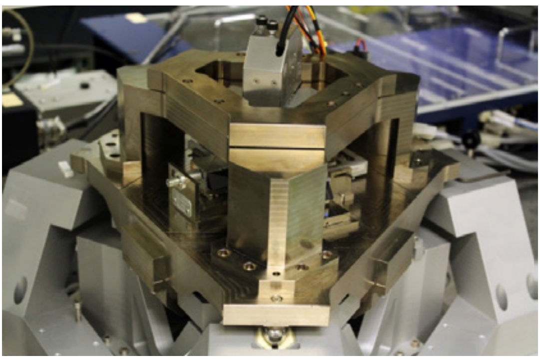
The Laboratory Ref4U of the University of Ghent (Faculty of Pharmaceutical Sciences) has a BELMET recognition to carry out and manage national standards and to ensure the traceability of measurements in the field of amount of substance concentration measurements, subfield clinical chemistry, namely the unit mole by cubic meter (mol/m^3) and the unit linked to it in mole per liter (mol/l).

These two laboratories are ISO/IEC 17025 accredited and notified by the National Standards Service as designated institute (DI) for these aspects to the Meter Convention (BIPM) and EURAMET.

4. Nanometrology

Nanoscience and nanotechnology cover key growth areas. Research at the nanoscale, or one billionth of a meter, fascinates both scientists and manufacturers who are increasingly investing in this field. Nanotechnology has great potential for application in various areas such as health, energy, environment, IT or common consumer products. Belgium is a major European player in nanotechnology. In order to support these technological developments at national and European level, the National Standards Service is engaged in research and development activities focusing on nanometrology and the statistical processing of measurement results.

The development of nanotechnologies as Key Enabling Technologies involves not only the development of new measuring and analytical instruments but also the creation of a unique platform that brings together various complementary tools. Nanometrology activities started in 2007 and are now contributing to the creation of a platform with unique instruments such as the metrological atomic force microscope (AFM) (see picture below). The laboratory also has two commercial atomic force microscopes, one of which is used for the characterization of biological materials in liquids.



Picture: Metrological atomic force microscope developed at the National Standards Service

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Within the large family of nanomaterials, nanoparticles are nano-objects with at least one dimension smaller than 100 nm. Because of their nature, shape and very small size, nanoparticles enable many specific properties to the matrices in which they are embedded. They are being increasingly used in sectors such as paints, cosmetics, textiles, food or health care. However, because of their size, shape and wide availability on the market, some nano-objects also represent a potential risk for public health and cause environmental problems. In order to ensure the development of nanoparticles while assessing the associated risks for public health, workers and environment, it is essential to accurately determine the features of these nanoparticles at the nanoscale and with a low level of uncertainty. This is one of the R&D objectives of the section.

The developments in nanometrology achieved by the National Standards Service aim to ensure the traceability of dimensional measurements using interferometric and diffraction techniques through comparison with standard laser wavelengths.

Measurement results must be associated with uncertainty estimates in order to be traceable to the International System of Units. At the nanoscale, the characteristics of particles (size, shape, ...) are averaged over a set of particles. It is therefore essential to estimate the statistical effect. To this end, new statistical data processing systems and new reliable mathematical models need to be developed. The use of microscopy opens up novel perspectives for estimating measurement uncertainty in image analysis. Moreover, the comparison of measurement results obtained with various techniques (microscopy, light scattering) requires on the one hand a good understanding of the physical principles behind measuring instruments and, on the other hand, an innovative approach to data analysis. All these new mathematical challenges are associated with the development of nanometrology and are part of the research process.

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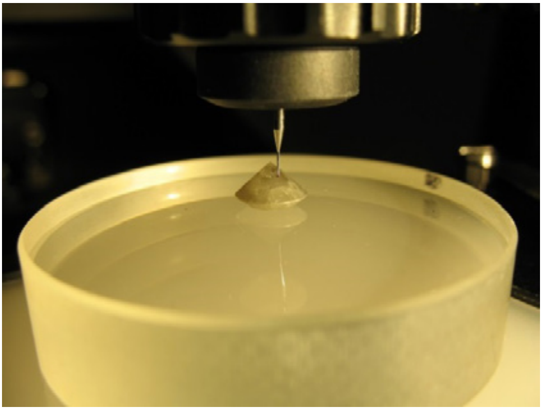
5. Dimensional Metrology

The two major roles of the dimensional measurement section are, on the one hand, the realization and the preservation of the national length standard and, on the other hand, the execution of calibrations, thus ensuring traceability to this standard and to fundamental physical principles. The section can also provide support on uncertainty calculation and measurement setup.

While delivering the best service in Belgium in the areas of traditional dimensional metrology, specific activities dedicated to nanotechnologies are being developed in two ways: first to propose national standards at the nanometer scale and second to propose calibrations with nanoscale uncertainties. For further info on nanometrology, see section 4 of this brochure.

Moreover, the section dimensional metrology takes part in the European projects of the metrological research programmes EMRP and EMPIR (http://www.emrponline.eu/).

5.1. Dimensional nanometric calibration



The most efficient way for traceable calibrations of simple and complex small 3D objects (micro parts) is measuring these objects with a coordinate measuring machine (CMM). Our CMM has a measuring volume of 130 mm x 130 mm x 100 mm and a measuring uncertainty in the order of magnitude of 0.25 µm + L / 666 (with L in mm). Developments are made to add a confocal probe on the machine reducing the uncertainty to approximately 20 mm to 40 mm. It is equipped with a tactile probe and an optical probe (camera). The tactile probe has a diameter of 0.3 mm and 0.12 mm allowing for measuring characteristics of small objects. The measuring force of the tactile probe is 500 µN.

The concept of the machine is based on a mechanically completely compensated thermal loop so that temperature variations have only a minor influence on the measurement uncertainty. The measuring axes are configured to ensure an optimal agreement with the Abbe-principle.

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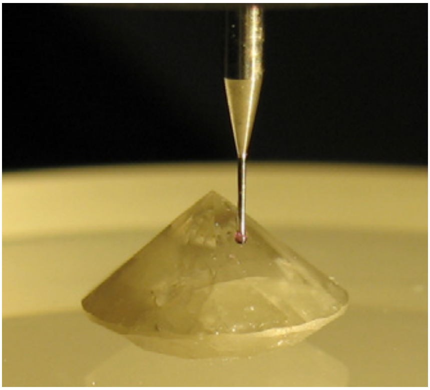


In addition to measurement with the µCMM, the following calibrations are available:

- Piezos and other position generators
  Range of measurement: from 0 nm to 5 mm

  Uncertainty (k = 2): $\sqrt{(1nm)^2 + (0.001 \cdot L)^2}$ (L is the displacement measured in nm)

- Capacitive sensor
  Range of measurement: from 0 nm to 5 mm

  Uncertainty (k = 2): $\sqrt{(1nm)^2 + (0.001 \cdot L)^2}$ (L is the displacement measured in nm)

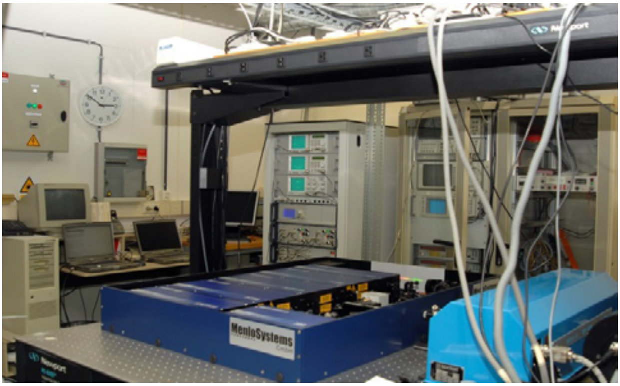
- Flatness (optical measurement)
  Maximum diameter of the optical flat: 150 mm
  Uncertainty (k = 2): from 10 nm
- Roundness (with the method of errors separation)
  Maximum diameter: 300 mm
  Measurement range: up to 200 µm
  Uncertainty (k = 2): from 10 nm
- Interpolation errors of laser interferometers
  Uncertainty (k = 2): 0.1 nm

The following calibrations are under development and will soon be available to Belgian economic stakeholders:

- Line scales, grids
  Measurement range in one dimension: up to 1000 mm
  Measurement range in two dimensions: 200 mm x 200 mm
  Expected uncertainty (k = 2): $\sqrt{(15nm)^2 + (0.06 \cdot L)^2}$ (L is the displacement measured in nm)

5.2. Classic dimensional calibrations

5.2.1. Laser wavelengths



The national standard of length (the meter) is realised with stabilised lasers with wavelengths (λ) of 633 nm (red) and 543 nm (green). These lasers are operated in accordance with the requirements specified in the international definition of the meter. These are Helium-Neon lasers, stabilised on adsorption peaks of the hyperfine spectral lines of Iodium$^{127}I_2$. The uncertainty on the wavelength of these lasers is $2.5\ 10^{11}\ \lambda$.

We also have an optical frequency reference generator, which can generate a laser beam with wavelengths ranging from infrared to blue light. This primary reference is driven by an extremely stable frequency signal coming from the cesium clock and the hydrogen atomic clock from the laboratory Time and Frequency. The uncertainty on the wavelength of these lasers amounts to $5 \cdot 10^{-14}\ \lambda$.

The stability of these lasers is checked through internal comparisons in the laboratory and by means of an international campaign of measurements comparisons, the so-called interlaboratory comparisons. The lasers are the basis for the calibration of wavelength of other lasers like those used in the interferometers to measure lengths, angles or flatness. They can also be used to check the wavelengths of other laser standards.

5.2.2. Laser interferometers

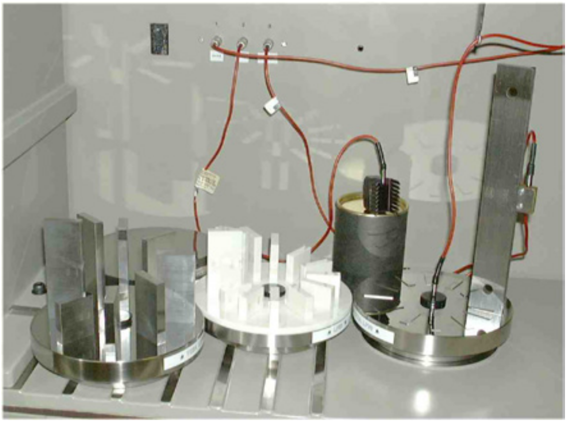
The calibration of a laser interferometer entails the calibration of the laser wavelength, the calibration of the various sensors for environmental settings and material temperature, checks of the calculation software precision and a functional calibration of the comprehensive system compared to a reference laser interferometer.

The calibration of laser interferometers includes the calibration of the laser wavelengths, the calibration of the sensors for the environmental parameters and of the sensors for the material temperature, a validation of the correctness of the calculation software and a functional calibration of the laser interferometer as a total system by comparison with a reference laser interferometer.

The environmental parameters air temperature, air pressure, air humidity and air CO_2 concentration are used for the calculation of the refractive index of the air and thus of the real wavelength during the measurements with the laser interferometer. The material temperature is used, together with the thermal expansion coefficient, for the calculation of the length at the reference temperature (usually 20°C) for an object that is measured at a material temperature that differs from the reference temperature. If desired, the corrections, used by the laser interferometer for the offsets of the sensors, can be adjusted.

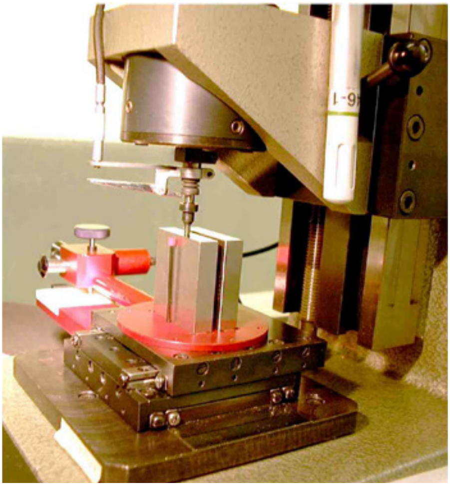
Checking the correctness of the calculation software for the refractive index of air, the material temperature and the calculation of the lengths, measured with the laser interferometer, is done by comparing a large number of results with the results calculated with reference software. The functional calibration of the system as a whole is done by measuring at the same time displacements with the laser interferometer to be calibrated and with a reference laser interferometer.

5.2.3. Calibration of gauge blocks



One of the applications of stabilized lasers in the section Dimensional Metrology is the interferometric calibration of gauge blocks with an interferometer of the Michelson type. This instrument offers, at this time, the best accuracy that can be obtained for the calibration of gauge blocks.

The length of steel, tungsten carbide and ceramic gauge blocks can be measured without contact, in function of the wavelength of the measuring laser beam. The necessary corrections are applied. One of these concerns the refractive index of the air and is based on the air pressure, the air temperature, the air humidity and the air CO_2 contents that are measured at each calibration. Another correction is the one for the change of length of the gauge block by temperature and is based on the measured gauge block temperature and its linear thermal expansion coefficient. The measurement range for the length of gauge blocks goes up to 300 mm in this configuration.

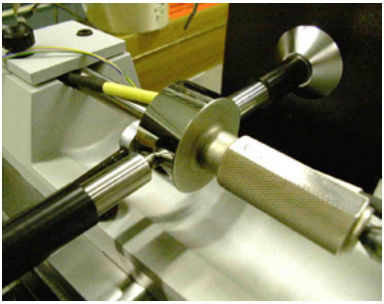


A gauge block comparator and a universal length measuring machine, protected against thermal effects, are used for gauge blocks calibration by comparison with similar material reference gauge blocks.

The reference gauge blocks up to 300 mm are regularly calibrated in our laboratory by interferometry.
For lengths above 300 mm, the reference gauge blocks lengths and thermal expansion coefficients are calibrated by foreign primary laboratories.

The measurement range is 100 mm for the comparator and 1,000 mm for the universal machine.

5.2.4. Diameter standards



The universal length measurement machine is also used for diameter calibration (plug gauges, ring gauges, spheres) as well as for some types of displacement transducers.

5.2.5. Line scales standards

Line scales up to 150 mm are calibrated using the measuring microscope, up to 3 m using a test bench equipped with a laser interferometer and up to 300 m using the interferometric decameter test bench (both interferometric devices provide thermal effects correction for the line scale temperature).

5.2.6. Hand instruments

The laboratory can also calibrate hand measurement instruments such as callipers, outside and inside micrometers, dial comparators, ...

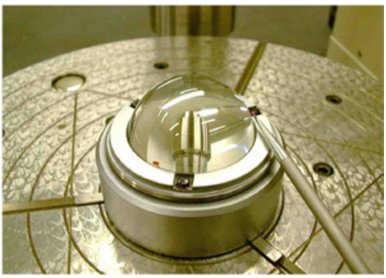
5.2.7. Optical flatness

Surface flatness calibration, for example optical flats calibration, is achieved by phase shift Fizeau interferometry and dedicated software.

This equipment allows calibration of optical flats up to 165 mm diameter with an uncertainty of some tens nanometer.

When using this method, the uncertainty on the flatness deviation is of the order of a few tens of nanometers.

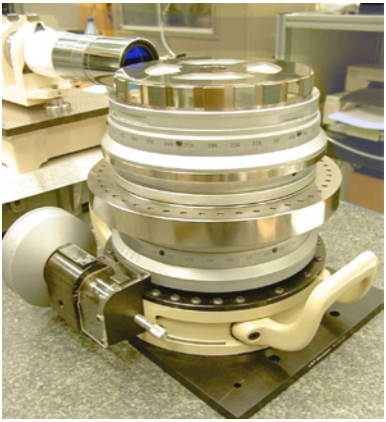
5.2.8. The deviation from flatness, roundness and cylindricity



The deviation from flatness of large horizontal surfaces, such as surface plates, and the deviation from straightness can be measured with precise reference electronic levels.

The calibration of the deviation from roundness and cylindricity is performed using a form measuring machine with a vertical and horizontal guide.

5.2.9. Angle standards



Angle calibrations are realized by two methods. The first one is based on the principle of closing the circle (accurate division of the circle). The second one is based on trigonometric methods (generation of a known angle by means of accurate reference lengths).

Circle division is employed for the calibration of polygons, indexing tables, angle block gauges, pentaprisms (optical angles), angular interferometers, clinometers, etc.

The trigonometric method is used for the calibration of levels and autocollimators.

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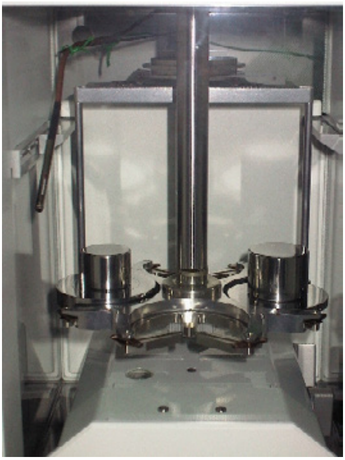
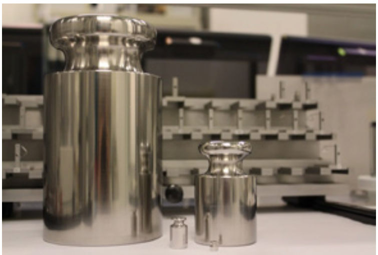
6. Mass



In Belgium, the National Standards Service of the FPS Economy is the holder of the national mass standards, the prototypes No 28 and No 37 in platinum-iridium.

Therefore, the mass section of the National Standards Service has been regarded as the primary laboratory for mass in Belgium since 1898.

The prototype No 37 took part in the third verification of the platinum-iridium prototypes, organized from 1988 to 1993 by BIPM, which is the owner of the international prototype K.

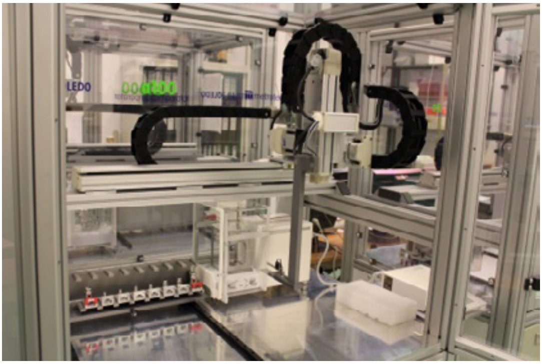


In 1996, our two stainless steel reference kilograms were recalibrated by comparison with prototype No 37. In 2005 one of these stainless steel reference kilograms was recalibrated by the BIPM. The other reference kilogram was recalibrated in 2006 in our laboratory.

All our standards submultiples and multiples of the kilogram are calibrated using these two reference kilograms.

The mass scale from 1 mg to 10 kg is established by using automatic comparators, either equipped with a carousel or integrated in a robot with a triple axis arm. As far as possible, we use the so-called closed series method (an application of the least-squares method).

The calibration of weights submitted to us, of the accuracy classes E1, E2 and F1, from 1 mg to 1 kg, is carried out using the same fully automatic equipment.



The capacities for measuring and calibrating (CMCs) related to the mass section can be found on the BIPM-website.

The mass section takes part in the mass comparisons organised by Euramet.

This allows us to establish how our reference kilograms, their multiples and submultiples are situated with regard to the similar standards of the other countries which are members of Euramet or EA.

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Weights from 1 mg to 20 kg

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Weights over 20 kg

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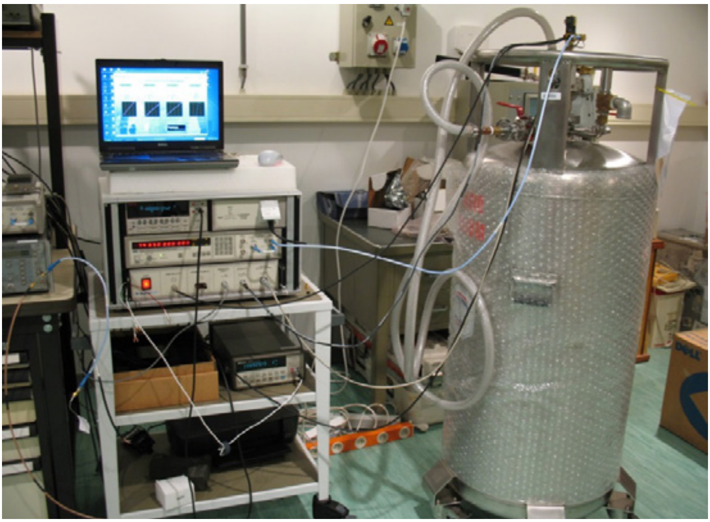
7. Electrical Measurements

7.1. DC voltage

The DC voltage is generated via the Josephson effect with the use of a fully automated Josephson Voltage Standard (JVS) that has been subject to a bilateral comparison to the BIPM travelling JVS in 2009 to ensure the traceability and international equivalence. In addition, a very low noise secondary voltage standard based on a Zener diode (Fluke 732B) is calibrated by the BIPM (International Bureau for Weights and Measures) every other year, in order to sustain our calibration capabilities.

The JVS also serves to determine the linearity of high resolution DC voltmeters and nanovoltmeters.



7.2. DC resistance

The legal unit of electrical resistance – the ohm – is directly traceable to the BIPM since 1948 by means of 1 Ω resistance standards and, since 1979, by means of 10 kΩ resistance standards.

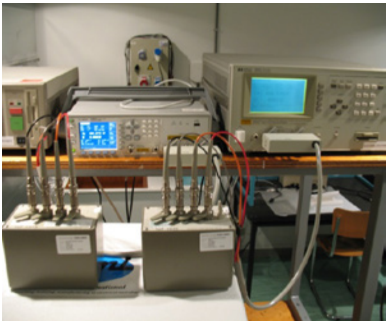
Measurements of resistance standards can be carried out between 100 μΩ and 10 kΩ by means of automatic direct current comparators. These devices are periodically externally calibrated up to 10 kΩ by using cryogenic current comparators.

From 10 kΩ to 10 GΩ, a measurement setup based on the switching technique for binary resistive voltage dividers is used. Ratio measurements up to 1000:1 can be performed with the use of a 100 V external source and a high resolution digital voltmeter serving as differential detector.

Very stable and accurate air baths are available for all calibrations.

7.3. LF impedance

7.3.1. Capacitance



The capacitance unit - the Farad - is maintained by means of a group of thermoregulated fused silica standard capacitors of 10 pF and 100 pF respectively. The calibration of standard capacitors having nominal values between 1 pF and 1 µF - at frequencies from 100 Hz to 20 kHz - is performed via the substitution method by means of an automated ultra-precision capacitance bridge. At higher frequencies (up to 2 MHz), precision LCR meters are employed. The substitution method is also applied for the calibration of four terminal pair standard capacitors whose nominal values range in decade from 1 pF to 1 µF, using calibrated capacitance standards of the same nominal values and automated LCR meters or capacitance bridges.

7.3.2. Inductance

The inductance unit (Henry) is maintained by means of a group of twelve standard inductors of toroidal type with nominal values ranging in decade between 100 µH and 1 H. The calibration of standard inductors is done using a substitution method between 100 Hz and 10 kHz by means of calibrated inductance standards of the same nominal values by automated LCR meters.

7.3.3. AC resistance

The calibration of resistance standards with nominal values ranging from 10 Ω to 100 kΩ, at frequencies up to 10 kHz, is performed using a substitution method. Precision LCR meters are used to calibrate the unknown standards against the national AC/DC standards.

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8. Time and Frequency

The National Standards Service bases its time/frequency measurements on a group of three commercially available caesium beam frequency standards and one hydrogen frequency standard. All are fitted with the high performing version of the beam tube.

These standards are working according to the last definition of the second adopted during the 13th General Conference on Weights and Measures held in 1967. The outputs of these standards can be used to generate traceable signals up to 50 GHz and from 60 GHz to 90 GHz. Frequency measurements are also possible up to 110 GHz. Electronic stopwatches, quartz and vapour rubidium gas cell oscillators are calibrated based on these caesium standards.

The traceability is assured by our participation to the Circular T, maintained by the BIPM, and our daily comparisons with other international time and frequency standards.

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Racks with caesium standards

- Accuracy ± 5 x 10^{-13}
- Long-term stability:

1 day: < 9 x 10^{-14}

5 days: < 5 x 10^{-14}

30 days: < 5 x 10^{-14}

- Short-term stability:

1 s: < 5 x 10^{-12}

100 s: < 8.5 x 10^{-13}

1000 s: < 3 x 10^{-13}

Hydrogen standard

- Accuracy: ± 5 x 10^{-13}
- Stability:

1 s: < 1.2 x 10^{-13}

10 s: < 2 x 10^{-14}

100 s: < 7 x 10^{-15}

1 hour: < 2 x 10^{-15}

1 day: < 2 x 10^{-15}

- Output frequencies: 1 PPS, 5 MHz, 100 MHz

GNSS-receiver: reception of GPS, GLONASS and GALILEO

Antenna (choke ring type) for the GNSS-receiver, mounted on the roof of our building

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9. Thermometry

The thermometry laboratory in Belgium realises part of the international temperature scale (ITS0 - 90) from the argon triple point (-189,3442°C) to the silver freezing point (961,78°C).

T90 (K)	t90 (°C)	Fixed point
13,8033	-259,3467	Hydrogen triple point
17,035	-256,115	Hydrogen vapor pressure at 33,3213 kPa
20,27	-252,88	Hydrogen vapor pressure at 101,292 kPa
24,5561	-248,5939	Neon triple point
54,3584	-218,7916	Oxygen triple point
83,8058	**-189,3442**	**Argon triple point**
234,3156	**-38,8344**	**Mercury triple point**
273,16	**0,01**	**Water triple point**
302,9146	**29,7646**	**Gallium melting point**
429,7485	**156,5985**	**Indium freezing point**
505,078	**231,928**	**Tin freezing point**
692,677	**419,527**	**Zinc freezing point**
933,473	**660,323**	**Aluminium freezing point**
1234,93	**961,78**	**Silver freezing point**

The national temperature references are transferred through standard platinum resistance (SPRT) thermometer calibrations.

Moreover, the section thermometry takes part in the European projects of the metrological research programmes EMRP and EMPIR (http://www.emrponline.eu/).

For this purpose, the laboratory equipment includes:

- fixed points cells Ar, Hg, H_2O, Ga, In, Sn, Zn, Al, Ag;
- reference SPRT and HSPRT thermometers;
- low temperature furnace (Ga);
- high temperature furnace (In, Sn, Zn);
- high temperature "heat-pipe" furnace (Al, Ag);
- 2 AC bridges (ASL F18);
- AC bridge (ASL F700);
- AC bridge (ASL F900).

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10. Volumes

The section in Haren of the National Standards Service calibrates standard capacity measures for testing measurement systems for liquids. The OIML Recommendation R120 is applied. The range of the nominal volumes for standard capacity measures is between 1 l and 100 l. The method used for the calibration of the measures with a nominal volume between 1 l and 10 l is the volumetric (filling) method. This method uses automatic pipettes with a nominal volume of 1 l, 2 l, 5 l and 10 l.

The method used for the calibration of the measures with a nominal volume of 20 l, 50 l and 100 l is the gravimetric method. This method uses a weighing instrument with a maximum range of 150 kg and a resolution of 1 g and a densimeter with a resolution of 0.00001 g/cm^3. The section in Haren of the National Standards Service also calibrates larger standard capacity measures. The method used for the calibration of measures with a nominal volume greater than 100 L is the volumetric (filling) method with automatic pipettes (nominal volume of 50 l and 100 l).

The section for the calibration of standard capacity measures applies a quality system in compliance with the ISO/IEC 17025 standard. The best possible measurement capabilities are described in the following tables.

The minimal uncertainty (l) is equal to 0.02 % of the volume of the standard capacity measure.

VOLUME BETWEEN 1 AND 10 l - VOLUMETRIC METHOD	
Volume of the measure (l)	Minimal uncertainty (l)
1	0.004
2	0.004
5	0.004
10	0.004
VOLUME BETWEEN 20 AND 100 l - GRAVIMETRIC METHOD	
Volume of the measure (l)	Minimal uncertainty (l)
20	0.006
50	0.006
100	0.009
VOLUME GREATER THAN 100 l - VOLUMETRIC METHOD	

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11. International activities

The National Standards Service represents the FPS Economy in the international (BIPM) and European (Euramet) organizations in charge of scientific and applied metrology. The service also supports the development and improvement of national and European regulations related to metrology.

The representatives of each section of the National Standards Service take an active part in the work of the Euramet expert groups. This participation has a double benefit:

- encouraging the exchange of knowledge and experience, as well as the implementation and constant improvement of measurement techniques,
- the validation of the measurement methods by participation in international comparisons for the different applications in metrology. The results of these measurement comparisons are essential for the national and international recognition of our calibrations. This national and international recognition of the calibrations performed by the National Standards Service is important, in particular for the measurements performed in Belgium or abroad by laboratories, companies and scientific institutes ensuring their traceability, directly or indirectly, through accredited calibration laboratories, to the Belgian National Laboratory.

The development and improvement of measurement standards requires increasing financial efforts. Therefore, several European countries, including Belgium, have decided to join efforts in metrological research. From 2007 to 2014, the European Metrology Research Programme (EMRP), co-financed by EU and 21 countries, invested more than 400 million euros in research projects to sustain the development of novel measurement possibilities that could have a strategic impact for Europe. A successor programme EMPIR was adopted in 2015 on the basis of article 185 of the European Treaty and is running till 2020.

A representative of the National Standards Service also takes part in the meetings of the Technical Committee for Quality of Euramet. In the TC-Quality, all national metrology institutes (NMI's) which are members of Euramet, present their quality system. The QS-FORUM also gives the opportunity to exchange experiences on the implementation of the ISO/IEC 17025 standard in a NMI.

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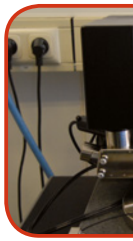
Abbreviations list

CMC	Calibration and Measurement Capabilities
BIPM	Bureau International des Poids et des Mesures
NMI	National Metrology Institute
AFM	Atomic Force Microscope
SI	International System of Units
JVS	Josephson voltage standard
AC	alternatif current
DC	direct current
LF	low frequency
RF	radio frequency
HF	high frequency
SPRT	standard platinium resistance thermometer
HSPRT	high temperature standard platinium resistance thermometer
PTB	Physikalisch-Technische Bundesanstalt
LNE	Laboratoire National de Métrologie et d'Essais
OIML	International Organization of Legal Metrology
EMRP	European Metrology Research Programme
EMPIR	European Metrology Programme for Innovation and Research

For the meaning of the units used, see the brochure ***Metrology in Short*** from EURAMET (http://www.euramet.org/).



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