HELLENIC
INSTITUTE OF
METROLOGY

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Building a competitive Greece
MINISTRY OF DEVELOPMENT

Colibri

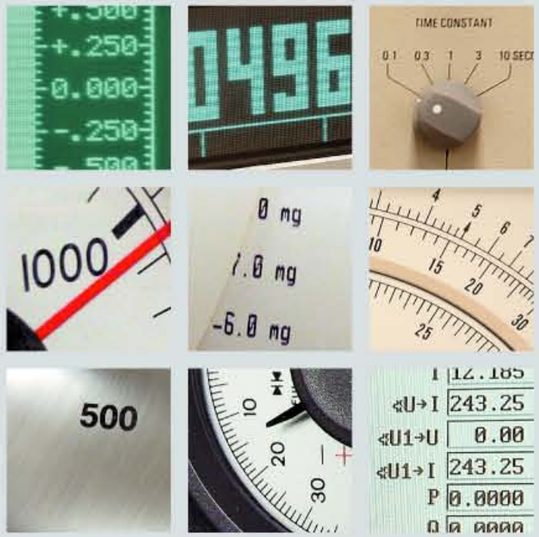
metrology science and development

The identity of the Hellenic Institute of Metrology

The Hellenic Institute of Metrology, EIM, with its modern infrastructures, state of the art technology and expert know-how, assures the measurement traceability to the S.I. units (Système International).

EIM develops activities, promotes co-operations and provides services, which contribute to the growth of the national economy and to the improvement of its competitiveness. These activities contribute to the quality of products and services, the improvement of methods and processes in manufacturing and production, the assurance of fair trade and the protection and safety of consumers.

< Mass Laboratory
Calibration of 10 Kg weight standards on an automatic mass comparator.



Metrology is defined by the BIPM as "...the science of measurement, embracing both experiment and theoretical determinations at any level of uncertainty in any field of Science and Technology." At the base of metrology are the definition, realisation and dissemination of units of measurement. This is achieved by:

- defining a unit, based on some physical constant, such as absolute zero, the freezing point of water, etc; or an agreed-upon arbitrary standard,
- realizing the unit by experimental methods and scaling it into multiples and submultiples, by establishment of primary standards
- transferring of traceability from the primary standards, to secondary and working standards, most often by calibration, ultimately establishing a relation between the indication of a measuring instrument and the value of a measurement standard.

Metrology a brief introduction

Metrology has existed in some form or another since antiquity. The earliest forms of metrology were simpe arbitrary standards set up by local authorities in order to facilitate commerce and record human activity. Progress with regard to metrology was made by various scientists during the Scientific Revolution, a time when it became evident that the comparison of experiment to theory required a rational system of units. Modern metrology has its roots during the French Revolution, with the concept of establishing units of measurement based on constants of nature, and thus making measurement units available "for all people, for all time". The result was the introduction of the decimal metric system in 1795, and the use of two platinum standards of the metre and the kilogram, against which all future copies were to be compared. In 1875 The Bureau International des Poids et Mesures (BIPM) was founded through the diplomatic treaty known as the Metre Convention so as to provide the basis for a single, coherent system of physical measurements throughout the world, the metric system. In 1960 it was decided at the 11th General Conference on Weights and Measures (CGPM) that the chosen system of units was to be the International System of Units (SI).

Metrology is a very broad field and may be be divided into three subfields:

- Scientific or fundamental metrology, concerned with the establishment of measurement units, unit systems, the development of new measurement methods, realisation of measurement standards and the transfer of traceability from these standards to users in society.
- Applied or industrial metrology, concerned with the application of measurement science to manufacturing and other processes and use in society, ensuring the suitability of measurement instruments, their calibration and quality control of measurements.
- Legal metrology, concerned with regulatory requirements of measurements and measuring instruments for the protection of health, public safety, the environment, enabling taxation, protection of consumers and fair trade.

"When you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind..."
Lord Kelvin

Temperature Laboratory >
Water triple points cell
Realization of the unit of temperature Kelvin

Scope and responsibilities of EIM

The main scope and the responsibilities of EIM nclude:

- The realization of all basic and derivative units of measurements of the International System of units (S.I.) through the use of the respective national standards.
- The development of measuring methods and techniques.
- The support of a national metrology system.
- The operation of calibration laboratories and the issue of calibration certificates.
- The testing of measuring devices for type-approval through the state-appointed body.
- The promotion of science of metrology.
- The development and the provision of certified reference materials.
- The national representation to international metrology organizations and fora.

The Hellenic Institute of Metrology

The Hellenic Institute of Metrology, EIM, is the National Metrology Organization of Greece and the official advisor of the Greek State in issues related to metrology and measurements. EIM is a legal body ascribing to the private law, supervised by the General Secretariat of Industry of the Ministry of Development. The headquarters and the facilities of EIM are located in the Industrial Area of Thessaloniki.

The Laboratories of Hellenic Institute of Metrology

Mass

Force - torque - hardness

Pressure

Density

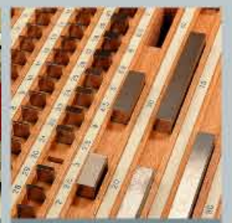
Liquid flow

Gas flow

Volume

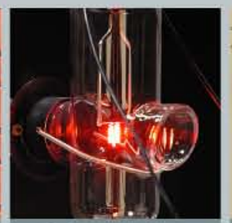
Temperature

Humidity



Dimensional Measurements

Acoustics & Vibrations



Optics Photometry

Electrical measurements in low frequencies

Electrical measurements in high frequencies

Time Frequency

Infrastructure

Mass Laboratory | Automatic data ?

Laboratory Infrastructure

EIM operates 15 central national laboratories, which realize, maintain and disseminate the national standards for the basic and derivative measurement units of the International System (S.I.), namely:

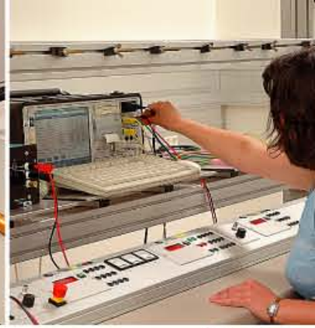
Kilogram (kg)
Meter (m)
Kelvin (K)
Ampere (A)
Second (s)
Candela (Cd)

as well as for many derived measurement units at the highest level of accuracy.

A peripheral national laboratory of EIM (EXHM/GSCL–EIM) in the field of chemical metrology operates in the facilities of the General State Chemistry Laboratories of Greece in Athens for the realization and the dissemination of the basic unit of the amount of substance (mol). A second peripheral national laboratory of EIM (HIRLC/HAEC-EIM) in the field of ionizing radiation operates in the facilities of the Hellenic Atomic Energy Commission (HAEC) in Athens for the realization and the dissemination of the S.I. units of Sievert (Sv) and Gray (Gy).

Most of the central and peripheral national laboratories of EIM possess state-of-the-art equipment, consisting mainly of primary standards, as well as secondary standards to cover the calibration needs of the country and to meet the quality control requirements of the laboratories.

3. Electrical measurements in high frequencies, Laboratory
Vector network analyser
4. Electrical measurements in low frequencies, Laboratory
Σύστημα Διακρίβωσης Μετρητών Ηλεκτρικής Ενέργειας
5. Electrical measurements in low frequencies, Laboratory



3 , 4

5

Volume Laboratory | 7 volumetric vessels

Building Infrastructure

EIM operates in modern facilities, comprising state-of-the-art building and supporting installations. It occupies two separate buildings, of 4.500 and 1.500 sq.m., with excellent environmental conditions, appropriate for the maintenance of the national standards.

Most of the laboratories are underground, protected from vibrations and noise, thermal effects and electromagnetic interference and meet the most stringent requirements for temperature, humidity, vibrations and electromagnetic interference, as prescribed by pertinent international standards and specifications.

1

2

investments

Investments in infrastructures and know-how in the period 1994-2006 exceeded the amount of 32.000.000 €, funded by the first, the second and the third framework support programs of the E.U.

1. Force Laboratory
Force standard machine
(Dead-weight and lever amplification
2. Dimensional Measurements Laboratory

Organisation and Personnel

EIM's strategy and policies are planned and decided by its seven member management council, according to the general policy of the Ministry of Development. The general director is responsible for the implementation of policies at the operational level with the support of the management structure of EIM.

EIM implements a quality management system according to the requirements of ISO 9001, ISO 17025 standards and legal requirements to fully cover the technical competence of its activities and services.

The scientific and technical staff of EIM is comprised of highly qualified personnel with extensive experience in the field of measurement science. EIM implements a program for the continuous training of staff engaged in laboratory and metrological support work, which partly takes place in National Metrology Institutes world-wide, in order to insure technical competence and acquaintance with cutting edge technology at the forefront of metrology.

Contribution to the economy and national growth

Activities and services
of the Hellenic Institute of Metrology

EIM as the advisor of the State and industrial partner

- Is the official advisor of the State on issues of metrology and measurements
- Realization of the basic and derived S.I. units and maintenance of the national standards
- Development of measurement methods and thechniques
- Support of the national metrology system
- Promotion and development of metrology
- Representation in international metrology organisations
- Metrological services in
  Calibration
  Metrology support
  Type approval

< **Pressure Laboratory**
Pressure balance
used in the realization
of the National pressure standards

Acoustics & Vibrations Laboratory | Anechoic chamber

Advisor of the State

EIM as the official advisor of the State:

- Provides instructions, recommendations and guidelines.
- Participates in committees, councils organised by the State, related to issues of metrology, quality etc.
- Cooperates and develops synergies with other bodies of the State in the framework of quality.

Realization of SI units and Maintenance of National Standards

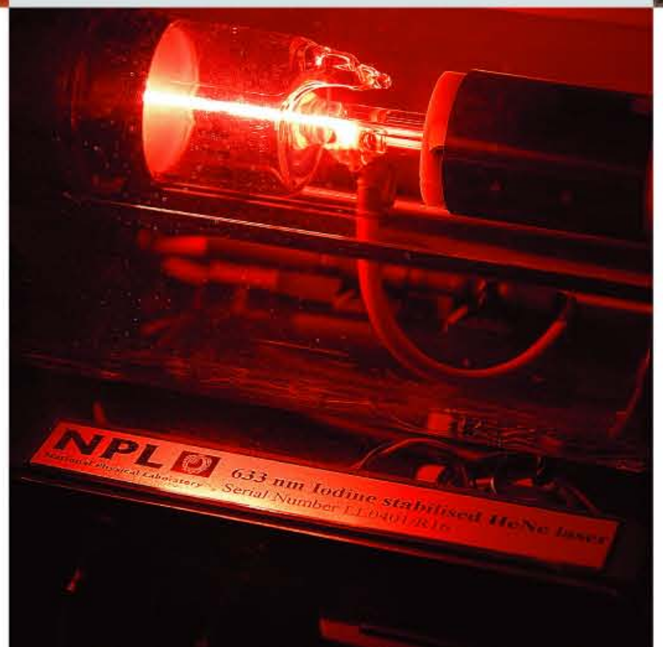
The National Laboratories carry out measurements and internal calibrations to provide full and reliable measurement traceability to the respective national standards. In addition, they verify their measurement capabilities and preserve their measurement traceability through their participation in international inter-laboratory comparison schemes in the framework of the Mutual Recognition Arrangement (MRA).

01. How important are measurements in the every day life of a person living in a developed country?

EIM It is estimated that up-to 6% of the GNP (Gross National Product) of a developed country corresponds to the cost of measurements undertaken in commercial transactions, quality and process control and testing in trade, industry, health and safety and environmental protection.

02. What is meant by an "accurate measurement result"?

EIM Any measurement results in an estimation of the "true" but unknown value of a physical quantity. In this respect, any measurement value should be accompanied by an appropriate parameter indicating how "good" this estimate of the "true" value is. In metrology, this parameter is called the measurement uncertainty and indicates the dispersion of the measurement results which can be attributed to the specific measurement of the physical quantity. For example, when measuring the mass of an object by the use of a balance, if the indication of the balance is 1,500 g and the measurement uncertainty is 1 g, this means that the "true" value of the mass of the object is between 1,499 g and 1,501 g with a certain probability.



Dimensional Measurements Laboratory >
National length standard

Dimensional Measurements Laboratory | Όργανα μέτρησης μήκους

Development of Measurement Methods and Techniques

The National Laboratories of EIM in the framework of maintaining their standards and participating in international intercomparison schemes, develop and adopt measurement methods and techniques as well as data analysis techniques for measurement uncertainty estimation.

Currently, there is an emphasis on activities related to the development of new measurement methods, techniques and technical expertise in metrology and measurements. Furthermore, the continuous strive towards improvement and upgrading of its measurement infrastructure has led to developing synergies with research and laboratory organizations in the country and abroad.

03. Are the consequences of unknown deviations of measurement results always significant?

EIM Unknown deviations of measurement results from expected values may have consequences that range from consumer safety and environmental protection to the cost and reliability of commercial transactions. The degree and the severity of their influence depends on the type of measurement, the accepted tolerances of product, process or method specifications and the unit cost of the measured quantities among other factors. For example, a systematic deviati on of 0,1% in the measurement of the production of electrical energy in Greece would correspond to an error of 50,000,000 kWh resulting in a 3,000,000 € annual revenue loss. In another example, random out of tolerance deviations of product batch attributes may lead to a substantial production cost increase and a decline in product demand, resulting in low market competitiveness, if this variation goes either unnoticed or is not resolved.

04. Do the metrological characteristics of a measuring instrument remain stable during its lifetime?

EIM The performance of measuring instruments during their lifetime is usually not time-independent resulting in variations of their metrological characteristics. These changes could result from use, for example, in "difficult" environmental conditions, various stresses or gradual wear incurred during their operation or even damage of the instrument. In this respect, inspection and calibration of measuring instruments are necessary at regular intervals.

Electrical measurements in low frequencies, Laboratory | Standard resistors

Electrical measurements in low frequencies, Laboratory
National standard of electrical resistance realised through quantum Hall ?

Volume Laboratory
Detail of a volumetric standard

A. EIM
B. Calibration Laboratories
Γ. Testing laboratories, quality control, users in: manufacturing, commerce, health, safety and environment

Support of the National Metrology System

EIM is at the apex of the National Metrology System. This network includes calibration and testing laboratories which perform measurements supporting a) industrial applications and process monitoring, b) scientific, technology and research development, c) trade and commerce, d) health and safety and e) environmental protection.

The pre-requisite for reliable operation of the Metrology System is the establishment of an unbroken chain of measurement traceability to the national standards of EIM, and through these to the respective international standards. In turn, reliability is a basic constituent for the acceptance of measurements encountered in all facets of every-day activities which influence decisions at all levels with regards to trade and commerce, manufacturing, environmental protection, health and safety.

In support of the National Metrology System, EIM provides:

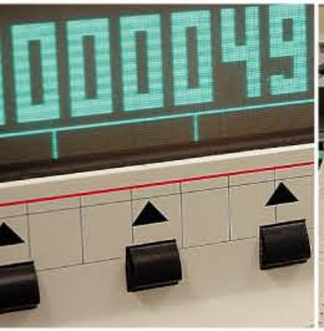
- Calibration services to calibration laboratories thus linking their reference standards to the national standards.
- Information, technical know-how, guidelines and training to calibration laboratories and other parties (testing laboratories, industry).
- Organization and assessment of inter-laboratory measurement schemes.

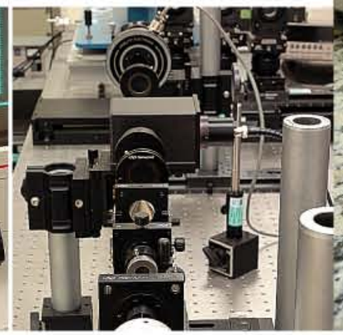
Promotion and development of Metrology

A major part of the activities of EIM is directed towards the promotion of metrology by convincing potential users of the positive impact that can be anticipated by the use of sound metrological principles in the assessment of various measurement problems. In addition, EIM assists in the correct implementation of measurement methods and techniques fit for purpose. The aim of these activities is to improve the National Metrology System resulting in better calibration services and measurement practices which reflect on the quality of products and services, the competitiveness of the economy and ultimately in the benefit of society.

To this effect EIM:

- Cooperates with Universities, academic foundations and research organisations in the country to promote education and training programs in metrology.
- Organises frequent meetings, symposia and events.
- Participates in conferences and events, related to quality.
- Organises in cooperation with the Hellenic Association of Laboratories (HellasLab) the Bi-annual National Metrology Conference.
- Develops continuous communication and cooperation with universities and academic institutions on measurement related issues.
- Organizes special training seminars to transfer technical know-how in metrology, calibration and relevant issues.
- Issues technical guidelines in calibration and quality issues.
- Publishes results in scientific and technical subjects in national and international journals/ conference proceedings.
- Provides continuous information to any interested party, through direct communication or through its website.





1. Electrical measurements in low frequencies, Laboratory
   Details of resistance calibration bridge
2. Optics - Photometry Laboratory
   Laboratory details
3. Mass Laboratory
   1 Kg primary ? standard

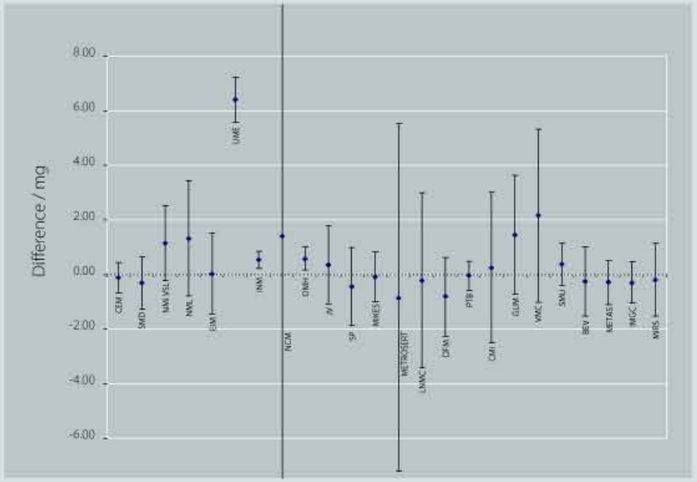
International Representation and International Relations and Co-operations

EIM represents Greece in the Meter Convention and BIPM (Bureau Internationale des Poids et Mesures), participates in the Mutual Recognition Arrangement (MRA) and is a member of the European Metrology Organization (EUROMET), which carries out the MRA process in the European area.

EIM develops bilateral and multilateral relations and co-operations with other organizations aiming at exchanging experience and know-how and dissemination of metrological knowledge. Emphasis of the international activities of EIM is given to the geographical areas of Eastern Mediterranean and Southeastern Europe with purpose the promotion and implementation of the European Model and the support of the efforts of the Greek business community, which is active in these areas.

EUROMET.M.M-K2 - Regional key comparison
Comparison of multiples and sub-multiples of the kilogram

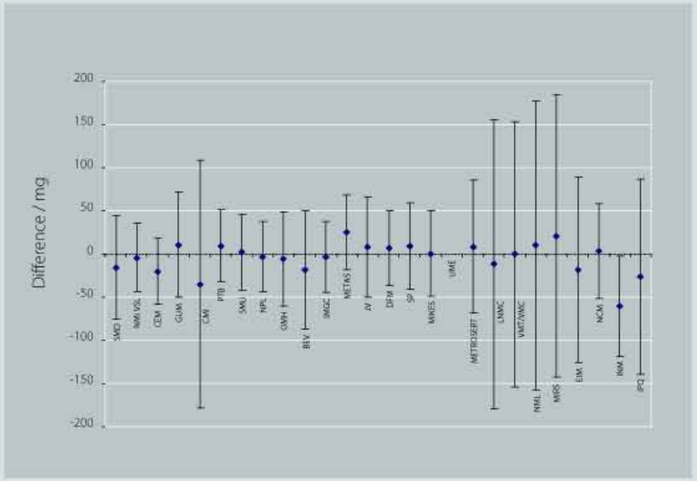
25 national laboratories participated. Measurements were conducted between August 2002 and June 2003. The purpose of the interlaboratory comparison was to link the results of the participating laboratories to the international key comparison, CCM.M-K2, carried out over the same range and organized by the CIPM. The intercomparison comprised of the measurement of mass standards with 5 nominal values: 100 mg, 2 g, 20 g, 500 g and 10 kg. SP of Sweden and NPL of the UK were pilot laboratories.



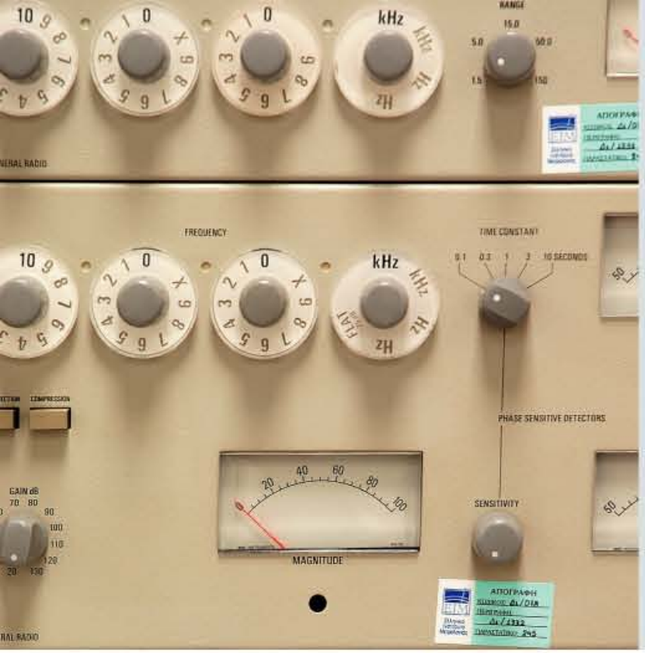
Results for the comparison of 10 kg weight standard.

EUROMET.M.M-K4 -Regional key comparison
Comparison of 1 kg stainless steel weight standard

Initially, 17 national laboratories participated to which 9 more were added. The purpose of the interlaboratory comparison was to link the results of the participating laboratories to the international key comparison, CCM.M-K1, carried out over the same range and organized by the CIPM. NPL of the UK was the pilot laboratory.



Results for the comparison of 1 kg weight standard.

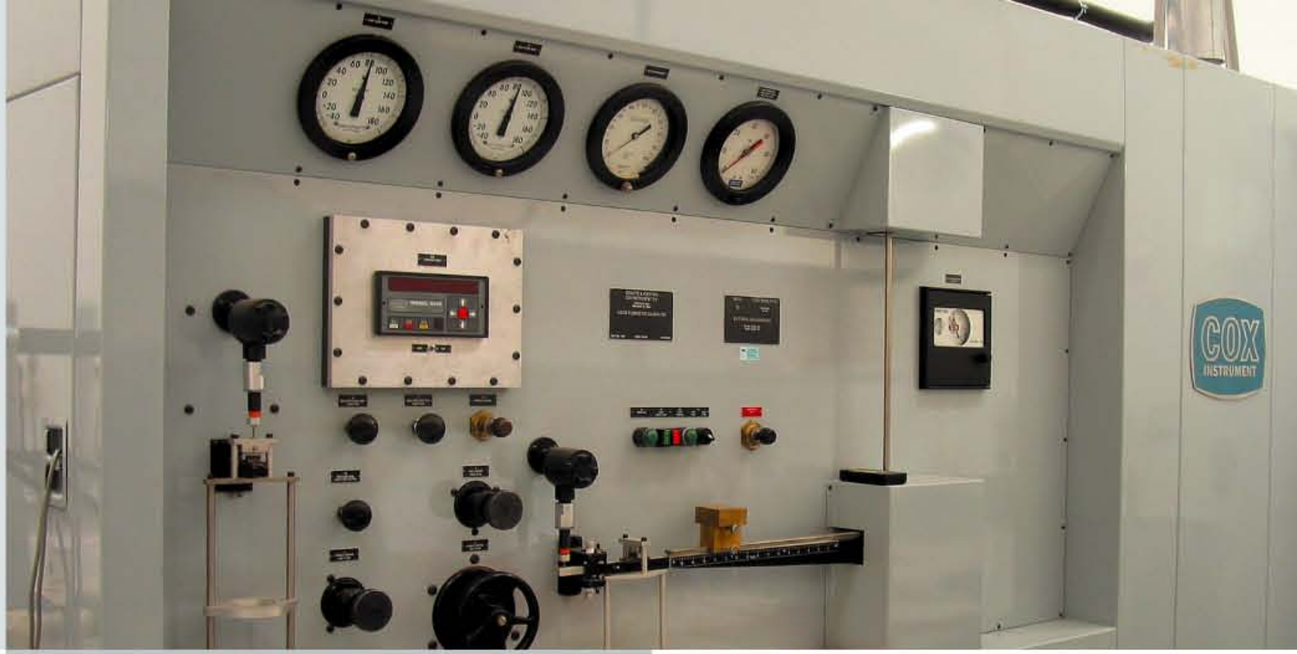


05. What does the "calibration of a measuring instrument" mean?

EIM A calibration determines the relationship between the indications of the instrument/system to be tested and a corresponding reference standard for a particular measurand. The determination of this relationship (correction to the indication of the instrument under test) is carried out by employing an appropriate measurement method and includes an estimation of the associated measurement uncertainty.

A reference standard:
- Has specific metrological characteristics making it fit for purpose (accuracy, repeatability, stability etc).
- Is compared with the instrument/ system under calibration at several points of its measurement scale.

An appropriate calibration method and procedure should specify, among other things:
- The number of points of the scale of measurement to be used.
- The number of repeated measurements to be carried out at each point of the measuring scale.
- The sequence of measurements to be applied.



Electrical measurements in low frequencies, Laboratory | Standard capacitor calibration system

Liquid flow Laboratory | Liquid flow primary standard

Services

The provision of services is the means for achieving EIM's basic objectives, as defined by its Service Policy and further specified within its service catalogue.

The basic principles of the policy of EIM are transparency, consistency and reliability of its measurement services while contributing to the moulding of an environment of healthy competition in the field of calibration services. The services are classified in three main groups, namely:

- Calibration services
- Services of metrological support
- Testing services in type approval of measuring instruments

The management of services comprises a major part of the administrative system of EIM. The above mentioned services are subject to continuous review and quantitative evaluation with respect to efficiency, customer servicing and satisfaction.

Calibration Services

Calibration services are mainly offered to calibration laboratories. In addition, calibration services are provided to third parties of the public and the private sector, especially in situations where their needs are not met by other calibration laboratories. All services are provided after an in-depth review of the technical requirements and availability of laboratory resources.

The main objective of the provided calibration services is the establishment of measurement traceability to the national standards.

Further information regarding details of calibration services and the laboratory technical capabilities is provided within the website of EIM (www.eim.gr).

calibration certificate sample

EIM has co-operations with a large number of organizations of the public and the private sector in Greece in providing services of calibration and support in metrology. In addition, bilateral cooperation has been established with organizations abroad and especially with the neighboring countries of the regions of S.E. Europe and E. Mediterranean in the field of services and know how transfer.

Electrical measurements in high frequencies, Laboratory
Vector network analyzer
Device for measuring connector tip depth and RF/mircrowave adaptors

Temperature Laboratory | Δοχείο υγρού αζώτου

Dimensional Measurements Laboratory | Lazer system accessories for the calibration of CNC, CMM and systems with precision moving parts

06. What characterizes reliable calibration services?

EIM Reliable calibrations of measuring instruments can be carried out by laboratories that meet the basic requirements of technical competence, i.e., they must have the appropriate infrastructure in equipment and facilities, use well established measurement and quality control procedures and employ adequately trained technical staff.

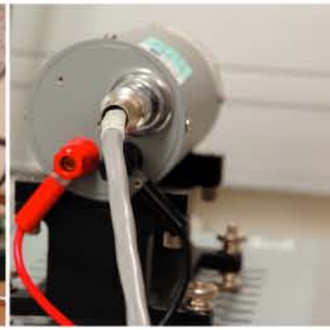
07. Can any laboratory in Greece, which is self-declared as a "calibration laboratory", be considered as appropriate for providing reliable calibrations services?

EIM This is not necessarily true. A calibration laboratory is considered to be reliable, in general, when the following criteria are met:

- The reference standards of the laboratory are calibrated and meet the requirements for measurement traceability to international standards.
- The laboratory has the appropriate infrastructure, i.e. building and laboratory facilities to meet the required environmental requirements, as well as the equipment and standards fit for purpose.
- The laboratory is accredited by the National Accreditation System of Greece (ESYD), or by another recognized accreditation body for the particular calibration service of interest.

Pressure Laboratory
Detail from pressure balance

Electrical measurements in high frequencies, Laboratory
Automatic power sensor
Calibration system (detail)



Services of Metrology Support

Services of metrological support are provided exclusively by expert staff of EIM and include:

1 Training and transfer of technical know-how in the fields of measurement and calibration techniques, measurement data analysis and processing including the estimation of measurement uncertainties in testing and calibration, organizing and maintaining quality systems in calibration and testing laboratories, through:

- Annual seminars upon open call held in Athens and the facilities of EIM in the Industrial Area of Thessaloniki.
- Seminars upon request from individual organizations either at their facilities or at EIM.

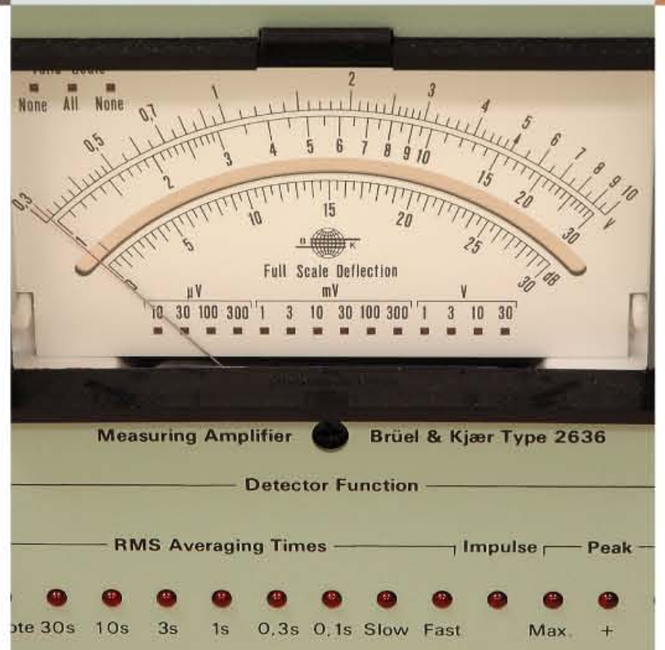
The above seminars have been organized by EIM since 2001 with the participation of over 100 organizations from Greece and abroad.

2 Expert advice and consulting in metrological and quality issues, such as:

- Evaluation and selection of measuring equipment according to specific needs and requirements.
- Development of measurement models and uncertainty estimation in testing and calibration.
- Development of custom measurement and calibration procedures.
- Organising testing, calibration and quality management systems according to international standard requirements.

3 Organization of inter-laboratory comparison measurement schemes at the national level for calibration laboratories:

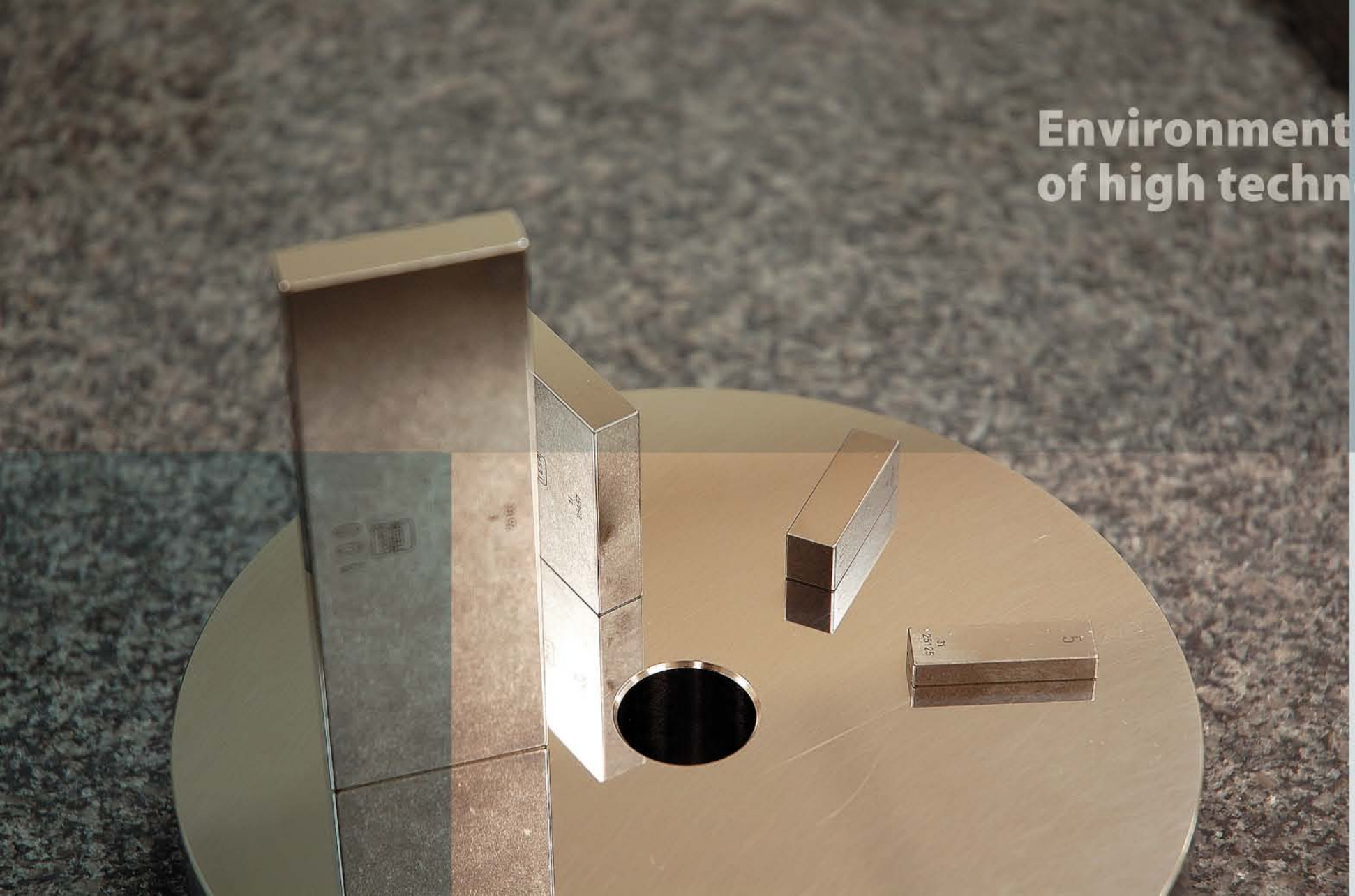
- seeking compliance with ISO 17025 requirements on technical competence and measurement quality assurance.
- interested in evaluating their technical competence via a bilateral comparison with corresponding EIM laboratories.



Testing for Type Approval of Measuring Devices

Testing of measuring instruments is undertaken according to the respective legal requirements and the international standards. The test report is submitted to the notified body, responsible for granting type approval to the interested party.

< Acoustics & Vibrations Laboratory
Sound level measurement
Instrumentation



Environment of high technology

The Laboratories
of Hellenic Institute of Metrology-EIM

mass
force – torque – hardness
pressure
density
liquid flow
gas flow
volume
temperature
humidity
dimensional measurements
acoustics & vibrations
optics - photometry
electrical measurements in low frequencies
electrical measurements in high frequencies
time - frequency

EIM

Mass
Laboratory

The Mass Laboratory realizes the SI unit of Mass via the maintenance of four 1kg reference standards of cylindrical shape manufactured from high quality stainless steel and traceable to the International Prototype Kilogram. The mass scale from 1 mg to 500 kg is disseminated by use of 6 automated high accuracy mass comparators and appropriate weighing schemes. The reliability of measurements performed in the laboratory is maintained by implementing a measurement quality assurance program based on statistical process control.

The Laboratory performs mass standard calibrations for the determination of true and conventional mass in the following ranges:

1 mg - 1kg with relative uncertainty to 0,15 ppm
1 kg - 50kg with relative uncertainty to 0,5 ppm
50 kg - 500 kg with relative uncertainty to 5 ppm

EIM

Force
Laboratory

The Force Laboratory, maintains state of the art facilities for the realization of the derived quantity Force, enabling calibration of force-proving devices up to accuracy class 00 according to ISO 376. The four Force Standard Machines within the laboratory enable the realization of force through:

fully automated exchange of dead weights (mass)
Range 50 N - 110 kN
Relative Uncertainty 20 ppm

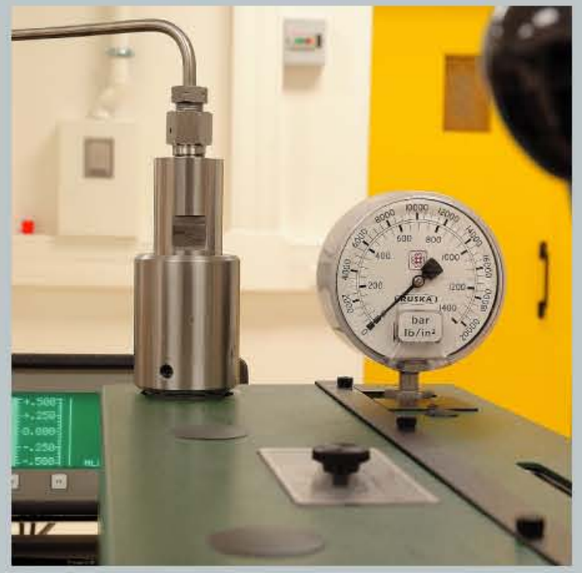
lever amplification (factor 10)
Range 10 kN - 1100 kN
Relative Uncertainty 100 ppm

automatic selection of hydraulic forces
Range 50 kN - 5000 kN
Relative Uncertainty 200 ppm

A number of force measuring devices which cover the full application range, including force transducers capable of measuring Fz (axial force) Mx My (lateral moments) and a build-up system (9 components) are also maintained. These devices are incorporated into a complete system of internal quality procedures for the characterization, maintenance and monitoring of the metrological status of the Force Standard Machines. Moreover, they act as force transfer standards, establishing traceability within the lab and disseminating accuracy to other machines or external laboratories.

EIM

Pressure
Laboratory



The Laboratory of Pressure realizes the unit of pressure (Pa) through the use of pressure balances. The latter are essentially pressure generating devices, in which the vertical upward force generated by the hydrostatic pressure to be measured, is balanced by the downward weight of a number of masses, acting upon a piston of accurately known surface, which moves freely within a cylinder.

The Laboratory has available 7 reference piston/cylinder assemblies, which use pure nitrogen or sebacate oil as pressure medium and cover the range -100 kPa to 140 MPa in gauge mode and up to 7 MPa in absolute mode, with relative uncertainties 35 to 100 ppm. Measurements are traceable to the German National Standards (PTB).

Additionally, the Laboratory can carry out traceable low pressure/vacuum measurements in the range 100 kPa to $1x10^{-8}$ hPa, with relative uncertainties ranging from 0,5% to 10%, through the use of a vacuum calibration system and appropriate vacuum gauge reference standards.

The Laboratory carries out calibrations of:

- **pressure balances, dead weight testers, ball gauges etc, through the use of the cross-floating technique**
- **digital and analog pressure measuring devices in the gauge, absolute and differential mode**
- **pressure transmitters**
- **vacuum sensors**

EIM

Density
Laboratory

The Density Laboratory realizes the derived unit of Density through two high quality polished single crystal Si sphere artefacts of mass ca. 1 kg traceable to the German National Standards of Mass and Length (PTB). Dissemination of the unit of Density to liquids and solids is accomplished by hydrostatic weighing in the ranges 600 - 2000 kg/m³ και 7700 - 8400 kg/m³ respectively, with relative uncertainty to 10 ppm.

The Laboratory performs density calibrations of:

1 mg-1kg weight standards

Range	7700 - 8400 kg/m³
Relative Uncertainty	10 ppm

2 kg-20kg weight standards

Range	7800 - 8300 kg/m³
Relative Uncertainty	0,06%

digital density meters

Range	600 - 2000 kg/m³
Relative Uncertainty	<0,01%

hydrometers

Range	600 - 1300 kg/m³
Relative Uncertainty	<0,10%

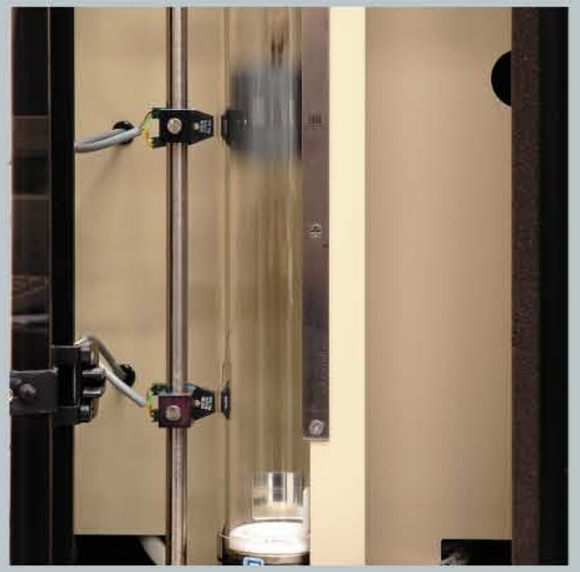
EIM

Liquid Flow
Laboratory

The laboratory of Liquid Flow maintains two primary flow facilities working in the range from 2.5 l/h to 100000 l/h. The realization of the unit of flow is based on the gravimetric and volumetric principle, respectively. Calibration services for all common flow metering devices are provided using water and MIL-C-7024 as calibration fluid. The measurement uncertainty of the two primary flow facilities is better than 0.2%.

EIM

Gas Flow
Laboratory



The Laboratory of Gas Flow realizes the unit of gas flow in facilities comprised of several commercial primary volumetric flow devices. All gas flow devices are working with clean, dry, compressed air up to 4 bar and upon request pure nitrogen can also be used. The gas flow laboratory provides calibration and testing services for all basic gas flow metering devices in the flow range from 0.5 l/h to 430 l/h and from 1 m^3/h to 130 m^3/h, respectively, with relative uncertainties better than 0.2%. All primary gas flow facilities are traceable to NMi (The Netherlands) and NIST (USA).

EIM

Volume
Laboratory

The Laboratory of Volume of EIM maintains facilities for calibrating laboratory glassware, metal volume provers and tanks based on established gravimetric and volume transfer methods. In particular calibration services are provided in house for the following categories:

laboratory glassware and volume standards

Range	5 ml - 20 l
Relative Uncertainty	better than 90 ppm

metal volume standards

Range	50 l to 2000 l
Relative Uncertainty	better than 200 ppm

proving tanks of capacity > 2000 l
better than 0.2%

All calibration services offered are traceable to the national standards of mass, density and temperature maintained at EIM.

EIM

Temperature
Laboratory

The Laboratory of Temperature realizes the unit of temperature, Kelvin (K), through the use of a number of water triple point cells. The International Temperature Scale, ITS 90, is realized through a number of different cells, of highly pure substances, which maintain extremely constant temperatures at the transition between solid/ liquid phase (fixed points). The laboratory's cells cover the range -189.3442 °C (fixed point of Argon) to 1,084 °C (fixed point of Silver). In addition, the Laboratory operates a number of additional equipment (baths, furnaces, standard thermometers, etc.) to transfer the accuracy of primary standards (cells) to lower temperature measuring standards.

The Laboratory carries out calibrations of:

- **standard and semi-standard resistance thermometers and thermocouples of noble metals directly** against the fixed points of ITS 90.
- **thermometers and temperature sensors,** through comparison calibration **in the range -80 °C to 1200 °C.**

EIM

Humidity
Laboratory

The Laboratory of Humidity operates a standard humidity generator, which creates an air stream of very accurately known dew-point temperature, in the range -20 °C to 90 °C, with traceability of measurements to our nnational standard of temperature (EIM). This humidity generator is used to calibrate directly the optical hydrometers of the Temperature Laboratory.

The Laboratory carries out calibrations of:

Optical dew point hygrometers
directly against the standard humidity generator
Temperature Range -20 °C to 90 °C.

Relative humidity (R.H.) sensors
through comparison calibration
Temperature Range 10 °C to 90 °C.

The range of relative humidity covered, is temperature dependent, i.e. at 20 °C, the range covered is 40% to 95% R.H.

EIM

Dimensional Measurements
Laboratory

The Laboratory of Dimensional Measurements realizes the unit of length (m) through the use of two He-Ne stabilized lasers. In addition, the laboratory equipment comprises a laser interferometer, a portable laser interferometer, a gauge block comparator, an autocollimator, a universal measuring machine, a coordinate measuring machine and and various equipment for roughness measurements.

The Laboratory carries out calibrations and measurements of:

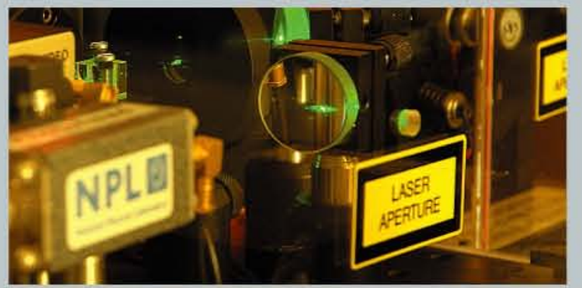
Gauge blocks (grade 00, K, 0) by the use of interferometry
Range 0,5 - 300 mm

Gauge blocks by comparison
Range 0,5 - 1000 mm

Standard angles and polygons

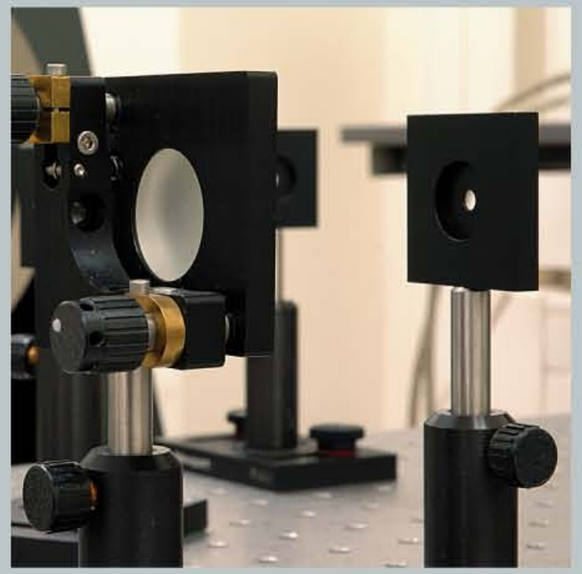
Sphericity, cylindricity, flatness, roughness, parallelity of various objects and standards

CNC machines



EIM

Acoustics and Vibrations Laboratory



The Laboratory of Acoustics and Vibrations realizes the unit (dB) through the use of a primary standard for the calibration of microphones as well as an anechoic chamber, according to the requirements of ISO 3745.

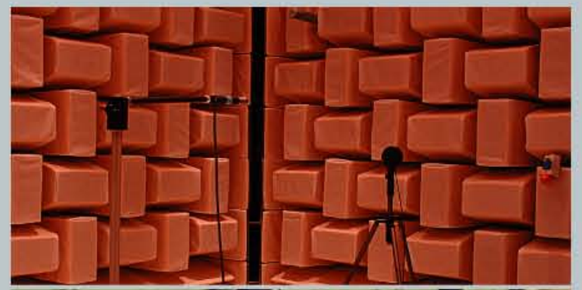
The Laboratory carries out calibrations and measurements of:

microphones by comparison with reference microphones with the use of the electrostatic activation method.

sound calibrators (class 0, 1, 2) and pistophones by the "Insert Voltage" method through comparison with reference pistophones.

sound meters according to the BS 7580 standard.

Acceleration sensors by comparison with reference acceleration meters, which are calibrated through leaser interferormetry.



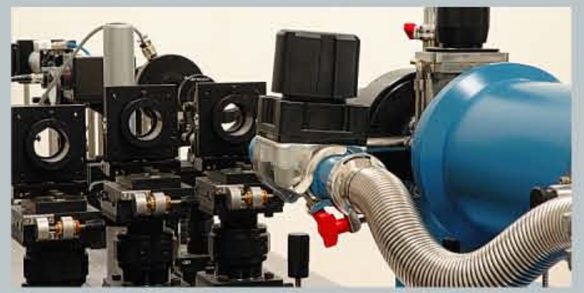
EIM

Optics - Photometry Laboratory

The Laboratory of Optics and Photometry realizes the basic unit of luminous flow intensity, Candela (cd), through the use of the following units and standards:

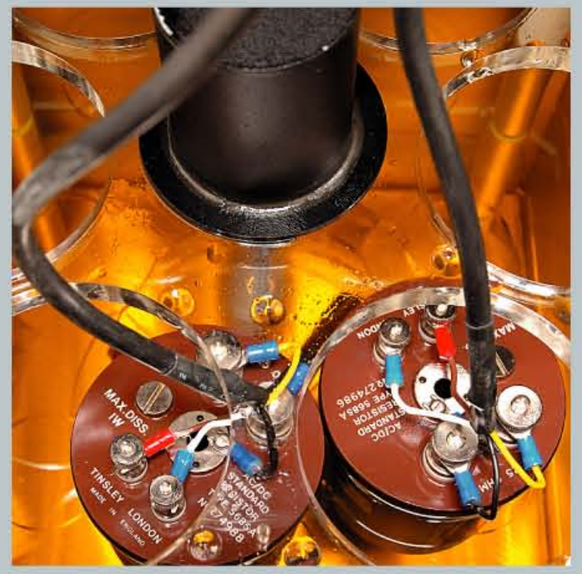
- Absolute radiant power calibration facility (Cryogenic radiometer-primary standard)
- Spectral responsivity calibration facility
- Photometry calibration facility

The Laboratory carries out calibrations and measurements of:
Laser power meters by the use of cw laser sources,
Relative spectral responsivity of optical radiation detectors,
Lamps for spherical irradiance by the use a detector stabilized transfer standard and the spectroradiometer facility,
Chromaticity and correlated colour temperature of light sources by the use of a photoelectric tristimulus colorimeter,
Luminance of sources and luminance meters,
Luminous intensity or illuminance of tungsten filament lamps and illuminance meters,
Luxmeters and photometers.



EIM

Electrical Measurements at low frequencies
Laboratory



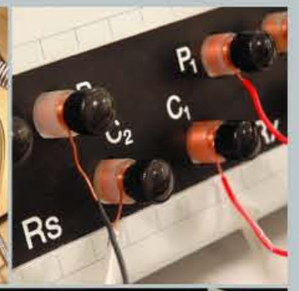
The Laboratory of Low Frequency realizes the voltage (V) (Josephson voltage standard, values 1V and 10V) and resistance (Ω) (Quantum Hall effect) through quantum effects, maintains the national standards of capacitance, electrical energy and AC/DC transfer and maintains a number of other systems for the transferring of accuracy.

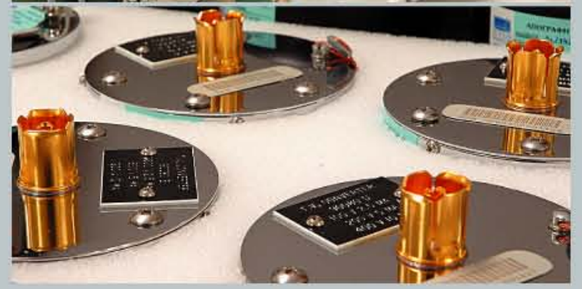
The laboratory offers calibrations of:

standards and measurement/generation systems of

- DC voltage,
- DC current,
- Resistance, capacitance, induction, AC/DC transfer,
- AC voltage and AC current.

voltage and current transformers and electrical energy measuring/generation systems.





EIM

Electrical Measurements at high frequencies
Laboratory

The Laboratory of Electrical Measurements at high frequencies maintains our national standards for:

Microwave power through the use of a microcalorimeter, which measures the efficiency of power sensors, thermistor & barretter type, for co-axial type N and 3.5 mm systems, with uncertainties better than 0.005 and 0.03, respectively

and Attenuation through the use of a standard piston attenuator, type WBCO-Waveguide below Cut-Off, with dynamic range 120dB, uncertainty less than 0.01 dB/10dB, linear range 90dB and uncertainty less than 0.001 dB/10dB.

In addition, the Laboratory operates vector network analyzers for the measurement of S-parameters in microwave networks with connectors of type N (0,045-18 GHz and 10Hz-500MHz) and type 3.5 mm (0.045-26.5 GHz), as well as a large number of measuring devices and equipment (automated system for the calibration of power sensors, generators, spectrum analyzers, oscillators, frequency counters, power counters, etc.).

The laboratory carries out calibrations of:
1) Power sensors and power meters, 2) Attenuators, 3) Spectrum analyzers, 4) Generators, 5) Frequency counters, 6) Oscillators 7) Amplifiers 8) Microwave passive devices, such as filters, dividers, etc.

EIM

Time - Frequency
Laboratory

The Laboratory of Time and Frequency realizes the units of time (sec) and frequency (Hz) through quantum phenomena using three primary standard Cesium clocks. The accuracy of UTC time 1 sec.

The laboratory performs measurements of:

time

Uncertainty	$2x10^{-14}$ (Time Base)

frequency

Range	up to 1.3 GHz
Uncertainty	$2x10^{-14}$

HELLENIC INSTITUTE OF METROLOGY