

# RESTRUCTURING LITHUANIAN NATIONAL METROLOGICAL SYSTEM

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*Abstract: This article sets out to explain the problems and barriers to restructuring Lithuanian NMS. It presents the approaches to the development and strengthening of the NMS adequate to the national resources available and capable to meet the further needs of consumers and the society in metrological service.*

*Keywords: metrological infrastructure, measurement standard*

## 1 INTRODUCTION

The national metrological system (NMS) is seen as one of the indispensable infrastructures needed supporting long-term stable environment for sustainable economy growth, and a prerequisite for industry's competitiveness. It provides measurement standards and the proper use of measurement methods to obtain valid measurement results as well as necessary organisation to ensure the measurements credibility.

The need to restructuring the Lithuanian NMS is based on the deep social and structural changes taking place in the Lithuanian economy. Lithuanian industry is slowly but bottoming up at present. Even now, the degree of economic integration into the EU and EFTA countries forms about 50% of exports as well as imports and it further increases. The common understanding of the fact that a sound metrological system is an essential part of the national quality infrastructure and a prerequisite for industry's competitiveness and success is becoming more and more evident. There is a growing demand for the implementation of the quality assurance standards, especially for calibration methods and evaluation of uncertainties of calibration and measurements. In 1996 the Lithuanian law on metrology came into force and this gives now a good base for the development of the Lithuanian NMS. On the other hand, taking into account the national capabilities and potential research environment the development and strengthening of the national standards system seems to be a continuous process.

Formulating a coherent and cost effective metrology policy is a complicated venture since there is a number of conflicts that are hard to resolve. For the purpose of this paper metrology policy encompasses all those measures that are deliberately meant to elaborate approaches to the restructuring Lithuanian NMS and further developing the measurement and calibration infrastructure compatible with EC member states' ones. The development concept should follow the evolution of technology in both equipment procurement and suitable staffing and operation.

The international collaboration with the neighbouring countries and partners in EC member states has been recognised as a main channel for the development of the functional networks underpinning the future development with the aim of finding realistic and acceptable solutions for users of the metrological services.

## 2 INHERITANCE

The priorities of the erstwhile Lithuanian metrological infrastructure were set mainly by the needs of industry. The basic consumers of metrological services, measuring instruments and testing equipment were research institutes and industry, e. g. mechanical engineering, instrumentation, radio engineering, microelectronics, electrical engineering, and chemical engineering. The universities, the institutes of Academy of Sciences and research laboratories were able to provide research and development methods and measuring instruments for measurements in such fields as semiconductor physics, high-frequency radio engineering, ultrasound, mechanical vibrations as well as to provide R&D in analytical chemistry.

However, measurement standards as well as scientific and methodical base in metrology were concentrated in a considerable extent in metrological centres of the former Soviet Union. Centres of

metrological expertise – research institutes or standard laboratories – were not available in Lithuania. Existing calibration laboratories were provided with ready-made testing instructions and normative documentation. Nowadays existing metrological infrastructure in Lithuania is based on the national capabilities available.

### 3 BARRIERS AND APPROACH

In economies in transition barriers to the development of efficient NMS can be classified into two types. The first type are generic barriers related to the relics of an economy and hassles inherited from the previous social system both in the industrial and metrological infrastructure, and peoples mentality and skills. The second type are barriers specific to metrological system. The latter include lack of comprehensive metrological policy and regulation, lack of institutional capacity, and weak enforcement.

Lithuania like other Baltic countries appear to face a unique barrier to the development of efficient NMS. This barrier is a function of relatively small size of the economies in each state and thus of the size of potential needs in metrological service.

Transition to an open economy results in demand for an effective NMS capable

- \* to adjust to changes in working environment,
- \* to support the competitiveness of domestic industry and economy,
- \* to meet the needs of consumers and the society in metrological service,
- \* to cope with the aims of European integration.

A research project there had been accomplished with the purpose of elaborating approaches to the restructuring Lithuanian NMS and further developing the measurement and calibration infrastructure compatible with EC member states' ones. Efforts were made by national administrative bodies, universities, public research institutes and industrial enterprises in

- \* making an inventory of the needs for metrology and testing activities in the country taking into account existing laws and regulations as well as already available calibration facilities,
- \* defining the priorities and possible alternatives for applicable national solutions of the national standards,
- \* promoting and updating of national metrology institutions, and creating a national source of measurement standards and expertise to support the calibration services,
- \* promoting of education, training and professional development of specialists in measurement science and technology,
- \* encouraging interaction and collaboration with partners in neighbouring countries as well as with partners in EC through joint activities in R&D.

Two key prerequisites to the concept of adequate NMS development are national resources and capabilities available as well as further demand for measurement credibility in the country. Elaborating a coherent metrological policy is not straightforward venture since there are a number of contradictions to be resolved. The primary task is to decide where to realise own national facilities or to seek possibilities for making use of and gaining access to the expertise and facilities owned by an other foreign NMI, [1]. The decision has been taken by Lithuanian Government to create the national source of metrological know-how and nationale reference center in order to encompass the organisation of fundamental metrology within a limited field, and form a basis for the traceability chains.

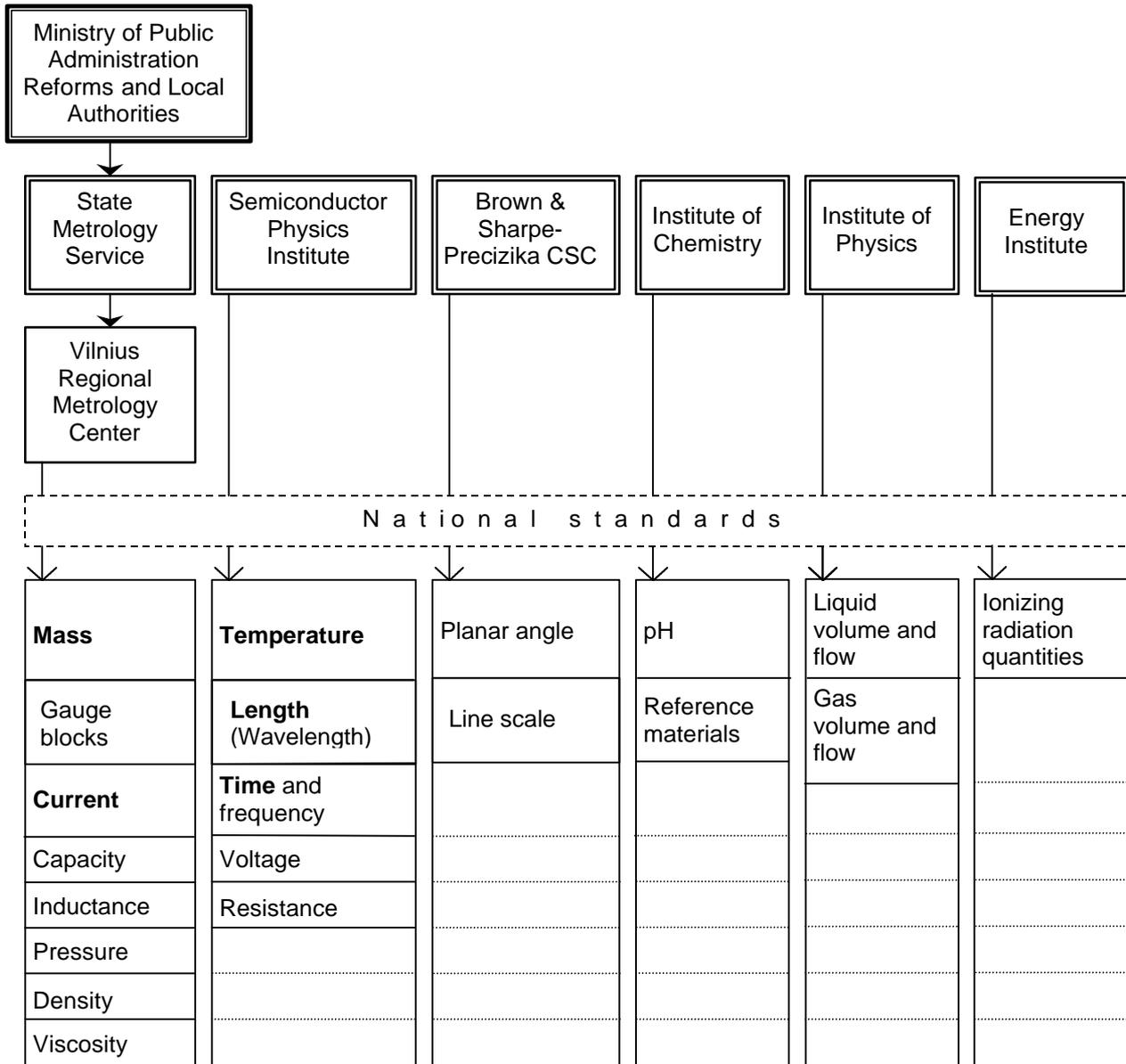
The special calibration facilities according to new needs of users (industry, transport, trade, and etc.) should be established and maintained on the commercial basis at the accredited calibration laboratories. Maximum benefit can be obtained of the joint approach and synergetic effects of the different institutions present in the metrological field, international co-operation including. This leads to a multidimensional network model and decentralised NMS structure.

### 4 STANDARDS

Measurement standards are basic point of departure for calibration/testing activities in the country. Experience of EU countries suggests, [1, 2], that international co-operation in measurement standards and exchange of expertise is a promising approach to improve efficiency and effectiveness of the national metrological systems as well as to cope with contemporary scientific and technological developments in the field of primary and national standards.

Establishing national standards for the realisation of the SI units and covering emerging needs is new areas are of the utmost importance to offer traceable calibrations to users. At present the reference

standards maintained at regional metrology centers cover the basic needs in metrological service. The national standards laboratories are to be established in the research institutions, in metrology centres, and in industry. Their task is to ensure that measurements expertise and traceability find the way out to users of metrological service. Due to this approach the Lithuanian national standards system will appear as a decentralised system, depicted in figure 1.



**Figure 1.** The organisational chart of the Lithuanian national standards service system.

The Lithuanian metrology service is co-ordinated by State Metrology Service (SMS), which operates under the Ministry of Public Administration Reforms and Local Authorities. In fulfilling its mandate SMS is advised by the Advisory Board for Metrology. The national standards laboratories are supervised by SMS. They hold the national standards, offer calibration services to calibration laboratories, which in turn offer calibrations for industry and other organisations.

Such a structure, on the one side, allows to exploit a core metrological capabilities available more fully, but on the other side where the tasks are divided between different organisations a close relation between

them is necessary to ensure efficiency of the system operation. Otherwise some costly overlap as well as lack of synergy and undesirable competition between institutions involved can hardly be avoided.

The first Lithuanian national standard - the national standard of temperature - has been established in 1999 to make available calibration facilities for the best equipment in the country. The standard covers temperature range between 83,805 K and 933,473 K in order to meet research laboratories' and process industries' increasing needs. Further the measuring range should be extended up to 1500 °C. Results of international intercomparison of the standard gave evidence of a very successful project: uncertainty of measurements  $u = 1$  mK has been clearly demonstrated.

Another example of the national standard development is the national standard of length, which should be covered by three organisations, see figure 1. In the common international practice, stabilised commercially available lasers form the basis for the realisation primary standards of length. The dissemination of the unit to fixed standards are governed by the interference phenomenon. Recent developments in interferential length measuring methods with visible light make high accuracy of dissemination of the unit of length to other wavelength standards, line scales and gauge blocks possible. The measurement uncertainty that can be reached is amounted to about  $\pm 0,1 \mu\text{m/m}$ , [3,4].

The calibration methods of the line scales, and gauge blocks as well as necessary physical environment conditions to be ensured in the length calibration laboratory are almost the same. The interferometers may use the same electronic units and meters for the environmental parameters evaluation/control as well as for the measurement data processing. Examples of this attitude are interferometers for calibration of length standards developed in MIKES, [3, 4]. The gauge-block calibrator is a scanning interferometer with a white-light source, [5], and 633-nm He-Ne laser. The laser measures the optical path length in the reference arm of the interferometer. The automated line-scale interferometer uses a dynamic measurement method with a microscope and CCD camera as the graduation line detector. The Abbé error can be minimised by adjusting the apex of the cube corner of the measurement arm. Combining both interferometers in one unit one can realise the standard of length on the basis of one multifunctional length-measuring machine, allowing comparison of long gauge blocks and calibration of line standards, and ensuring the traceability for the unit of length, [6], see figure 2. The rationale behind such a concept is that this may allow having one centre of metrological expertise in accurate length measurement/calibration and economising the costs of holding the national length standard, especially taking into account relatively small size of potential needs in metrological service in the country.

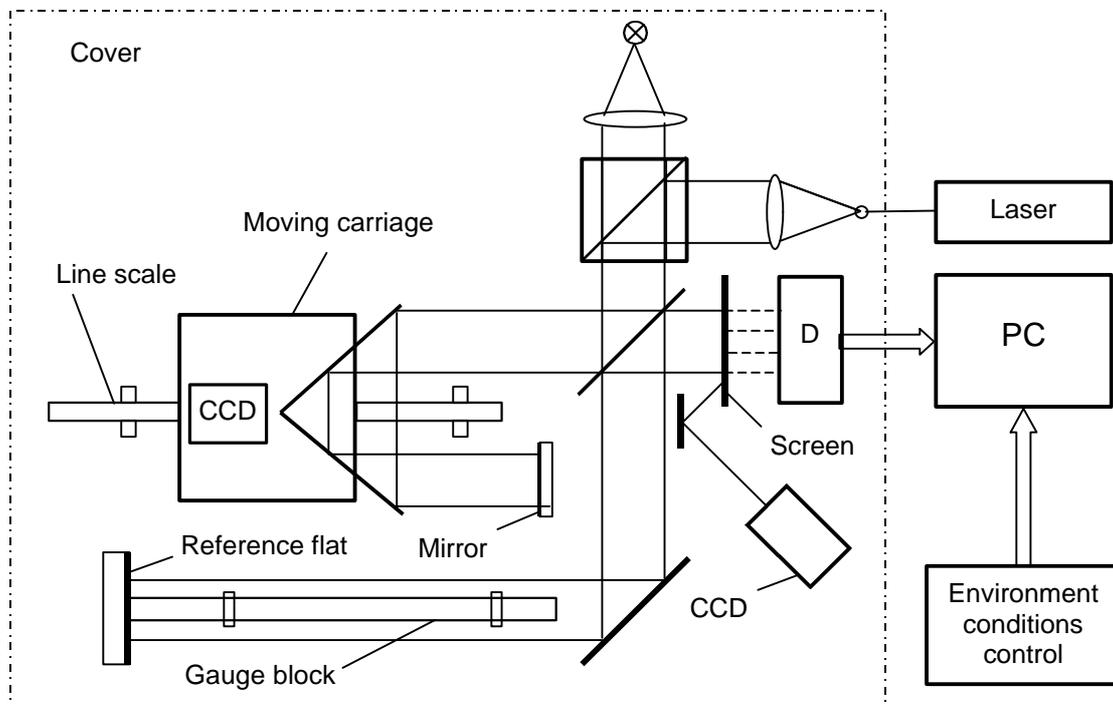


Figure 2. Schematic drawing of the line scale and gauge block interferometer.

## 5 CONCLUSION

Problems in the field of metrology and measurement technology in Lithuania are to be solved in a fundamentally changing environment inherited from the previous social system as well as in the newly born and rapidly changing economic conditions. Nowadays metrological infrastructure is based on the national capabilities and potential research environment available.

Restructuring of the Lithuanian national metrological system and strengthening its capacity is a part of an ongoing learning process. It can hardly be expected to work efficiently from the onset. The international collaboration with the neighbouring countries and partners in EC member states has been recognised as a main channel for the development of the functional networks underpinning the future development with the aim of finding realistic and acceptable solutions for users of the metrological services.

## REFERENCES

- [1] EUROMET Consultation on Facilities, EUROMET guidance document no. 71, EUC(98)6 4403 JCP.
- [2] Ulla Lähteenmaki, Metrology in Finland, *Centre for Metrology and Accreditation*, 1995.
- [3] E. Ikonen and K. Riski, Gauge-block Interferometer Based on One Stabilised Laser and White-light Source, *Metrologia*, **30**, (1993), 95-104.
- [4] A. Lassila, E. Ikonen, and K. Riski, Interferometer for Calibration of Graduated Line Scales with a Moving CCD Camera as Line Detector, *Applied Optics*, Vol. 33, No. 16, June 1994, 3600-3603.
- [5] D.J. Pugh, A White Light Interferometer, *National Physical Laboratory*, UK, 1987.
- [6] S. Kausinis, A. Kasparaitis, A. Isoda, J. Kumetaitis. Ilgio vieneto nacionalinio etalono sandaros galimybes, *Matavimai*, 2(7) (1998) 18-22, (in Lithuanian).

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