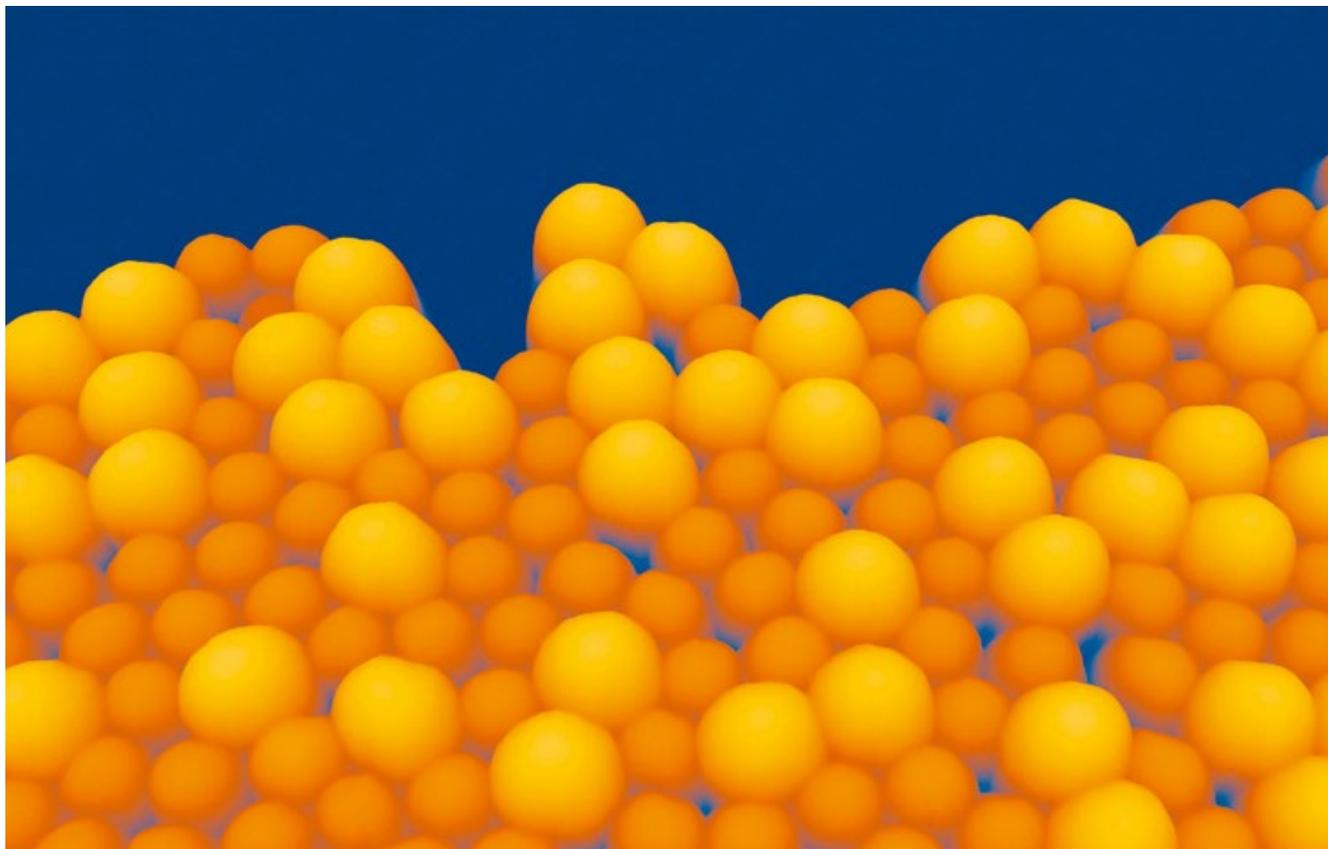




Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Federal Institute of Metrology METAS

Swiss Confederation



METAS in 2015

Publisher's details

This report aims to provide an overview of the activities of METAS in the reporting year 2015 in an understandable form. Further information can be gained from the Annual Report of METAS, the annual report on the implementation of the Measuring Act (both published on www.metas.ch), the Executive Pay Reporting (published on www.epa.admin.ch) and the short extracts of the Federal Council regarding the fulfilment of the strategic objectives of the independent units of the federation (published on www.efv.admin.ch).

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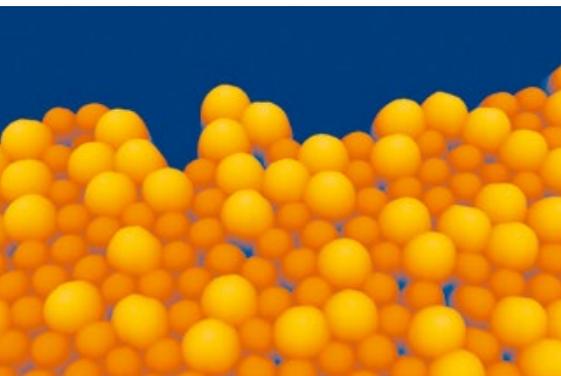
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Reliable measurements of smallest metabolic products of somatic cells (known as micro-vesicles) can be useful for medical diagnoses. To validate the methods developed synthetic reference particles of uniform size and those with two dominating sizes were compared in terms of size distribution and the long-term stability in a measurement comparison. (p.10).

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Research and development are essential for METAS



METAS can only keep its measuring stations and testing equipment up to date through research and development. This is required so that the services offered can continuously be adapted to the new demands placed on measurement technology and its foundations. In order to be able to finance the research activities necessary for its

metrological core tasks, METAS must exploit synergies and develop sufficient independent resources. Good and useful research and development depend primarily on competent and dedicated employees. METAS possesses this; as evidenced not least by the good results obtained in the customer and employee satisfaction survey.

Satisfied employees

The employee survey which saw a participation rate of 84 percent shows very high employee satisfaction and good employment conditions. Both are important prerequisites for the performance of METAS.

The present director of METAS, Dr. Christian Bock, has been appointed director of the Swiss Customs Administration by the Federal Council as of 1 April 2016. During his time at METAS he was not least responsible for the conversion of the Federal Office into a decentralised management unit and the development of new fields of business. The Institute Council would like to thank Christian Bock for his efforts on behalf of METAS and wishes him well in his new position.

On 25 November 2015 the Federal Council re-elected the Institute Council for the new term of office from 2016 to 2019. I look forward to being responsible for the strategic direction and business leadership of METAS together with my colleagues and the new management in the coming years.

Prof. Dr. Martina Hirayama
President of the Institute Council

Good and useful research and development depend primarily on competent and dedicated employees.

The success continues

For the third consecutive year METAS can report a healthy balance. All indicators look encouraging. The financial result is positive – despite the unfavourable economic situation. The number of research and development projects financed by external funding continues to increase, whether as part of the European Metrology Programme for Innovation and Research (EMPIR) or the Commission for Technology and Innovation (CTI). In the new METAS activity areas new skills are continuously built up. Our goal is to offer new metrological services that are tailored to the needs of industry.

Satisfied costumers

METAS conducted two surveys in 2015: a customer satisfaction survey and an employee survey. The job satisfaction of METAS employees is abnormally high. The value achieved is amongst the highest within the federal administration and retaining this very high level of job satisfaction is one of the major challenges of the coming years.

The overall customer satisfaction with services provided by METAS is highly valued as also shown in the previous survey in 2012. Customer satisfaction is mainly due to the quality of the work performed by our employees. These represent the highest-rated point of the survey, something of which I am inordinately proud. The customer survey also provided us with some indications as to where we can implement improvements in the future. It is of utmost importance to us to do everything possible to continue to provide impeccable services in the interest of customer satisfaction.

The present report provides an overview of the activities of METAS in 2015 with its positive development for our employees and for our customers.

Dr. Philippe Richard
Acting deputy director



The customers and employees of METAS expressed a high level of satisfaction.



Guiding METAS: the Institute Council and the Executive Board

At the head of METAS is the Institute Council. Composed of five members, it is responsible for guiding the business. The operative management is in the hands of the Executive Board.

The five members of the Institute Council possess in-depth management experience and extensive experience in research and development in both sciences and technology spanning many years. Its president is Professor Dr. Martina Hirayama. The duties of the Institute Council are defined in the Institute Act. It applies to the Federal Council for the monies for services to be provided by the Federal Government and authorises the research and development programme. It exercises a supervisory role over the Executive Board and issues the personnel regulations. In late November, the Federal Council re-elected the Institute Council for the new term of office from 2016 to 2019.

Defining the strategic orientation

Among the Institute Council's most important tasks is to define the strategic orientation of METAS which it carries out in conjunction with the Executive Board. In so doing, it follows the Federal Council's guidelines set out in the strategic goals for METAS. The Federal Council expects METAS to provide industry, the scientific community and the public administration with an effective metrological infrastructure together with the necessary measurement principles and metrological services.

The Board is responsible for the operational management of METAS. It represents METAS to the outside world and in the reporting year was composed of the Director, Dr. Christian Bock, and his two Deputy Directors, Dr. Philippe Richard and Dr. Gregor Dudle. In early December, the Federal council appointed Dr. Christian Bock Director of the Swiss Customs Administration; he will leave METAS in late March 2016. The post of Director of METAS was advertised. At the same time the Institute Council appointed Dr. Philippe Richard as acting Deputy Director for the period from 1 April 2016 until a new Director takes office.



The members of the Institute Council from left to right: Dr. Tony Kaiser, member; Prof. Dr. Ulrich W. Suter, Vice-President; Prof. Dr. Martina Hirayama, President; Dr. Matthias Kaiserswerth, Member; Prof. Dr. Thierry J.-L. Courvoisier, Member.

Measuring across borders: International metrology organisations

METAS – and thus Switzerland – is very well represented in international metrology organisations. In particular, METAS plays an active and shaping role in the European Association EURAMET.

International cooperation is essential in the field of metrology. Only this made it possible to replace the many mass units and systems of units of regional validity coexisting side by side with the globally valid International System of Units (SI). The basis of the SI is the Metre Convention, an international treaty from the year 1875.

Important technical committees

The organs of the Metre Convention are the guardians of the System of units (SI). Great importance is attached to the *Comités consultatifs* (CC) of the International Committee of Weights and Measures (CIPM). The actual scientific and coordinating work of international cooperation in metrology is carried out in this committee. Changes important for METAS took effect in two CC's: METAS is newly a member of the "*Comité consultatif des unités*" (CCU), which is itself responsible for the SI. This is a great recognition of the performance and the reputation of METAS, because membership in the CCU is traditionally reserved for the big metrology institutes. METAS is now also a member of the "*Comité consultatif de l'acoustique, des ultrasons et des vibrations*" (CCAUV). METAS is also directly represented in the CIPM by the Deputy Director Dr. Philippe Richard.

METAS plays an active role

In EURAMET, the Association of National Metrology Institutes of Europe, METAS plays an active and forming role and participates both in the technical committees as well as on the management committees. In the summer of 2014, the research manager of METAS, Dr. Beat Jeckelmann was elected chairman of EURAMET. He took office in June 2015 and will serve until mid 2018. Dr. Hanspeter Andres, the Head of Analytical Chemistry in METAS, is also the Chairman of the Technical Committee "Metrology in Chemistry".



Dr. Beat Jeckelmann and Dr. Hanspeter Andres, two representatives of METAS in international metrology organisations.

These and other commitments in international metrology organisations are also a reflection of the fact that METAS and its employees are internationally appreciated as a competent and reliable partner.

Measurement for industry and society: The role of METAS

Wabern, the place with the most accurate measurements in Switzerland. Here the Federal Institute of Metrology METAS is at home – the metrological reference centre of Switzerland.

METAS is the Swiss national metrology institute. It serves as the federal centre of competence for all issues related to measurement and for measuring equipment and measuring procedures. Through its activities in research and development and its range of services, METAS is instrumental in ensuring that measurements can be performed in Switzerland at the level of accuracy demanded by industry, research, administration and society.

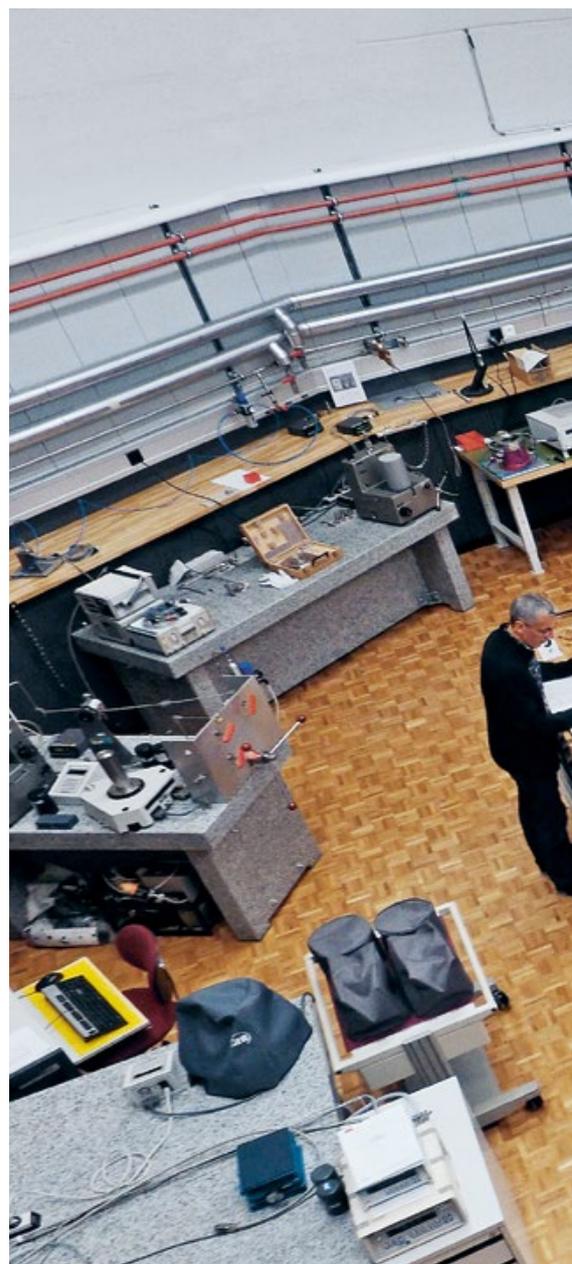
Authoritative reference standards

METAS realises the Swiss reference standards, ensures their international recognition and disseminates them with the requisite degree of accuracy in each case. In this way it provides industry and society with a basic metrological infrastructure that is important wherever measurements are made.

METAS oversees the market launch process, use and control of measuring equipment in the retail trade, traffic, public safety, health and environmental protection. It makes sure that the measurements required for the protection of people and the environment can be carried out correctly and in the prescribed manner.

Metrology

Metrology is the science and technology of making measurements (from the Greek word *metron*, meaning “measure”). *Metrology* is frequently confused with *meteorology*. However, these two fields are clearly distinct. *Meteorology* is the study of weather phenomena (from the Greek word *meteoros*, meaning “raised from the ground”).



Progress demands precision

Reliable manufacture and monitoring is only possible with the aid of accurate measuring systems. New scientific and technological developments are therefore dependent on constantly evolving metrological principles and processes. Important branches of the Swiss economy such as micro and medical technology or applications such as measuring and control procedures call for measuring methods with an accuracy that may lie in the order of millionths of a millimetre.



METAS keeps up with scientific and technological developments in order to maintain its place at the cutting edge. It is engaged in research and development with a view to improving measuring stations and metrological services. It regularly reviews its range of services and adapts it to market needs.



The place with the most accurate measurements in Switzerland:
at METAS in Wabern.

Projects for measuring: METAS Research and development

METAS mainly conducts its research and development activities under the European metrology research and development programmes (EMRP and EMPIR).

In 2015 METAS participated in the EMPIR programme with project submissions on the key topics “Metrology for Health”, “International System of Units”, “Pre-normative Research” and “Research Potential”. Six project proposals were successful. Our success rate is 54 percent, well above the average of the participating institutions.

Reliable reference values for medical diagnostics

Microvesicles are particles in body fluids with a size of approximately 20 nm to 1 micron. They are excreted as metabolites of cells. The analysis of the number, size, shape and other parameters of these particles can be used in the early diagnosis of cancer and contribute to the prevention of thrombosis. The aim of the EMRP project “MetVes” completed in 2015 was to establish the basis for the reliable measurement of microvesicles. Specific methods have been developed at METAS to perform dimensional measurements of biological samples with an atomic force microscope (AFM). Dozens of such measurements have already been taken. Individual AFM images are of an up till now unattainable quality and show images that till now only have been achieved using much more elaborate methods. Morphological differences between vesicles from different cells were discovered towards the end of the project. If this is confirmed, it would result in an



interesting method to determine the biological origins of vesicles. To validate the methods developed by the project partners synthetic reference particles of uniform size and those with two dominating sizes were compared in terms of size distribution and the long-term stability in a measurement comparison.

Modernisation of the International System of Units

An integral part of work for the fundamental revision of the International System of Units (SI) is the new definition of the kilogram, to relate the kilogram to a natural constant. With its Watt-balance

EMRP and EMPIR

The EMRP research programme (European Metrology Research and Development Programme) and the follow-up programme EMPIR (European Metrology Programme for Innovation and Research) were developed by EURAMET, the European Association of National Metrology Institutes, and the EU commission. Their goal is to coordinate the research conducted by the national metrology institutes more effectively and to strengthen metrological collaboration.



METAS has for some time been involved in the necessary experimental preparations. For the practical realisation and dissemination of the new kilogram definition the knowledge of the behaviour of mass standards, the reference materials for the size of “mass”, must be improved. In the EMRP project “NewKILO” METAS has developed new cleaning methods to reliably and reproducibly determine contamination on the surface of mass standards and remove. In particular, these methods allow for a stable and well quantifiable change in the surface state during the transition from vacuum to air and vice versa.



Developing measurement methods for medicinal purposes:
Measuring microvesicles (metabolic products of cells).

Measurement in the service of product development: Cooperation projects with industry

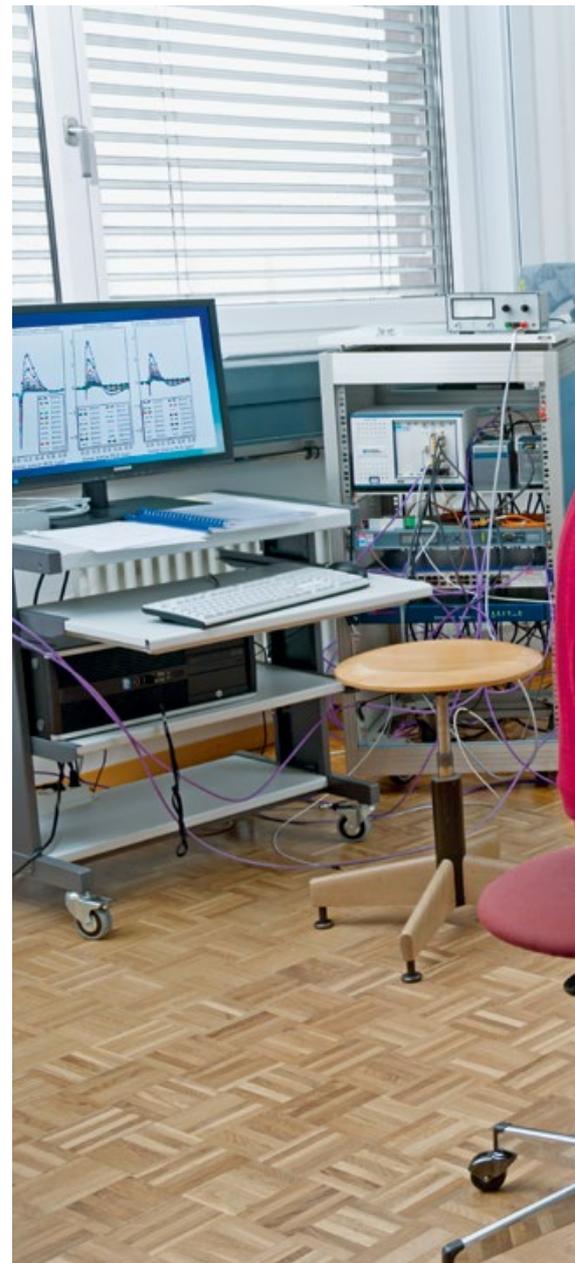
Since 2013 METAS is the mandated Research institution of the Commission for Technology and Innovation CTI. In this way companies can use the research and development capabilities of METAS for their innovations and developments and carry out projects in applied research and development together with METAS.

The scientific and technical know-how developed at METAS is not only available for industry in the form of calibration and measurement services, but also directly for their product and process development. METAS can be an interesting partner for them in various fields. Thanks to its services, the METAS labs interact closely with metrologists and development departments in industry. The cooperation with industry in the form of investment projects will be further expanded. So far, eight proposals for CTI projects with METAS as a research partner have already been approved.

Secure testing techniques thanks to traceable measurements

High-performance brake discs made of carbon-ceramic composite materials are already being used in vehicles in the upper price range. The Swiss company Proceq SA manufactures measurement instruments, which make it possible to determine the wear of such discs through an inductive measuring technology. The method is fast and safe and has great advantages in comparison to the traditional weighing method which is used today. The use of ceramic brake discs is also foreseeable in other categories of vehicles. The company Proceq SA intends to develop a new generation of test instruments based on the induction method. The objective of a CTI co-funded development project entitled "Reliable integrity evaluation of ceramic brake disks" was to round out the measurement concept with a robust and reliable modelling of the measurement process. Thanks to the development work of METAS, the relationship between physical parameters such as geometry and conductivity of the brake

disk and the measuring signal of the test device could be established. Thus the display of the measuring device could be traced back to units of the International System of Units (SI). A suitable reference material has been developed to calibrate individual test devices. The improved measurement method that enables a reliable determination of the conductivity of composite materials has been patented.





Alignment of research and development

The research and development of METAS focuses on projects the results of which are, on the one hand, directly required by the administration and politics to carry out their tasks and, on the other, by the Swiss economy and research to provide internationally recognised metrological infrastructure and specific metrological services.



Brake discs in the process of being tested.

Measurements in the service of communication technology: Metrology for the economy

With its services METAS helps numerous companies in various economic sectors in Switzerland to perform correct measurements. Ensuring in this way that these can satisfy the quality requirements that are imposed on their products.

METAS provides numerous calibration, measurement and testing services for the economy. In 2015 nearly 4500 calibration certificates and inspection reports were issued. With these services more than 4.3 million Swiss francs were generated, which represents an increase of one percent in comparison to the previous year. The most important customer segments are the engineering, electrical and metal industries and companies concerned with medicinal and communication technology. About 40 percent of the services are provided to foreign customers.

The right measurement is crucial

The measuring instruments and standards calibrated by METAS are often at the top of the calibration chain. The correct measurement is imparted in the form of internationally agreed and accepted reference values. A large number of further measurements depend on a reference value imparted by METAS. It is thanks to this seamless calibration chain that it can be assured worldwide that locally manufactured products fit together and meet the high and transnational quality requirements.

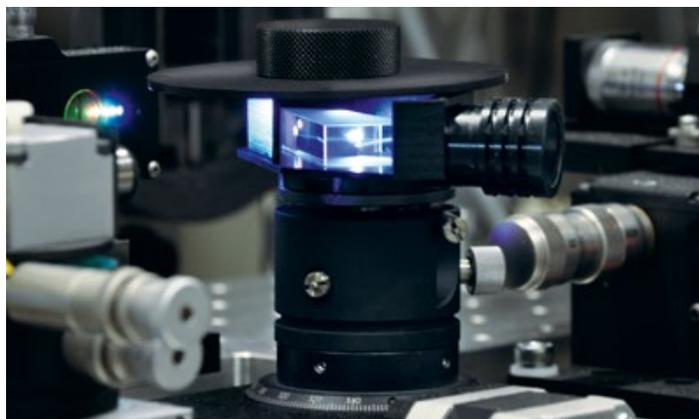
Broadband communication requires precise coordination

Continuously larger amounts of data are transferred in our modern information and communication society. This would be impossible without fibre optic technology. At first, glass fibres were only used in the main data strands. Gradually, they were applied in almost all computer networks. Meanwhile more and more companies and households – *Fibre to the home* – are connected to fibre networks. For a perfect match and the verification of the reliability of fibre optic networks, a variety of highly specialised instruments for measuring parameters such as wavelength, power, attenuation or dispersion are required.

Reference artefacts

METAS not only calibrates such devices, it also distributes reference artefacts with which other laboratories or other users can calibrate instruments and check measuring devices for the fibre-optic communications to standards. These artefacts are made of carefully wound coils with special fibres, packed in a sturdy housing with appropriate connections. They are made, calibrated and sold worldwide by METAS. So the METAS services also ensure that fibre optic communication networks can be operated reliably and matched perfectly even at ever increasing transmission rates.





Standards for communication services: measuring reference artefacts.

Transmitting knowledge of measuring: METAS courses and training

Since 2003 METAS has been providing classes on metrological issues. Basic courses as well as specialised thematic courses are offered. The course programme is aimed at a broad professional participant group.

Continuous training is essential in today's professional world. Evidence of course participation is often a standard requirement, as well as in ISO 17025 ("General requirements for the competence of testing and calibration laboratories"). In Switzerland in the field of metrology – apart from training of verification officers – neither training nor comprehensive or specialised training opportunities have been available up until now. Therefore, since 2003 METAS has offered a corresponding course programme. In 2015 seven courses were held, which were attended by 85 people. These provide participants with insight into various metrological subjects over a total of 159 course days, ranging from the concept of measurement uncertainty to electrical calibration technique.

Fundamentals of metrology

The one-day course "Fundamentals of Metrology" introduces participants to the basics of metrology and the technical requirements of ISO 17025. It is aimed at a broad specialist audience without any special previous knowledge and forms the basis for participating in other function-specific advanced courses.

In the two-day courses "Fundamentals of measurement uncertainty" and "Measurement uncertainty and conformity assessment", the contents are further advanced through practical exercises. These courses require good mathematical knowledge and are addressed to testing and calibration specialists. The courses enable participants to independently analyse measurement processes and to be able to create a sound and compliant uncertainty budget for a measurement. Next participants learn to assess the conformity of their product considering the measuring uncertainty with predetermined specifications. All three courses are regularly offered in German and French.



Courses on specialist subjects

The METAS laboratories further offer courses more focused on aspects of specialist subjects, such as length measurement, electrical calibration, analytical chemistry, pressure measuring technology, fibre optics, for exhaust gas measuring equipment or flow measurements. These courses take place several times a year or every few years in German, French or English, as required.

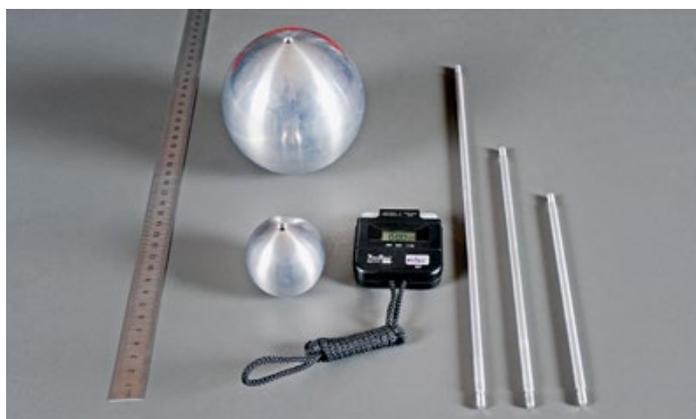
In addition to the fee-based Metrology courses, METAS also each year offers further training for verification officers under the terms of its legal mandate. Every three years basic training for aspiring



verification officers is also offered. Successful completion of the five modules of this basic training is a prerequisite for admission to the higher technical examination for the profession of Federally qualified verification officer.

Training on site

METAS also offers on site training. In June 2015 a course of the high-frequency laboratories was even carried out at a leading manufacturer of high-frequency measuring devices in California. For on-site training on fundamental aspects of metrology, a new specific two-day course has been designed with elements of basic courses. The course programme can be found on www.metas.ch/kurs.



Clearly elaborated: Experiment to determine the measurement uncertainty.

Certifying watches: a new METAS service

With the certification of mechanical watches METAS has added a new activity. This service is available to all Swiss watch manufacturers.

During the reporting year, METAS has developed and offered a new service: the certification of mechanical watches. The impetus to develop this offer came at the request of the watch manufacturer OMEGA. METAS was able to conclude a long term cooperation agreement with the company. Naturally METAS also extends this new service to all Swiss watch manufacturers.

Resistant to strong magnetic fields

The METAS certification of mechanical watches builds on existing certifications, and in particular the famous COSC certification of watch mechanisms. The “Contrôle Officiel Suisse des Chronomètres” (COSC), an independent, neutral testing laboratory performs tests on watch mechanisms. Watch mechanisms which successfully pass the multi-day tests are issued with an COSC certification. Only a mechanical watch with a COSC certified watch mechanism may be referred to as a “chronometer”.

The certification by METAS is in addition to the existing COSC certification and also requires a high level internal quality control of the manufacturer. The watch mechanisms together with the watches themselves are tested. The requirements for certification are specifically designed to test the resistance of the watch to strong magnetic fields. The watches have to withstand magnetic fields with a magnetic flux density of 1.5 Tesla (15 000 Gauss). In comparison: The Earth’s magnetic field has a strength of approximately 40 micro-Tesla (0.4 Gauss) on the surface. METAS has adhered to the certification requirements of watch mechanisms and mechanical watches that are resistant to magnetic fields of 1.5 Tesla in a normative document, which is published on the METAS website. This includes both the technical as well as the organisational requirements.



Monitoring of the test method

The certification is designed to ensure that the manufacturer examines all watches to be certified in accordance with the specified technical requirements. METAS monitors the manufacturer’s test procedures. The test monitoring is composed of METAS firstly performing checks on samples. Secondly, the test data are statistically evaluated by METAS. A watch that has been successfully tested in accordance with the requirements may be designated as “MASTER CHRONOMETER”.



In order to be able to carry out the random checks on the samples, METAS has built and operates its own test laboratory in a factory building of OMEGA in Biel. Access is restricted to METAS employees. A number of different METAS laboratories were involved in the construction of the laboratory and the calibration of the devices, in particular the photonics, time and frequency lab, the mass, force and pressure lab as well as the DC and low frequency laboratory.



One of the foundations for the certification of mechanical watches:
The newly established test laboratory of METAS in the OMEGA building in Biel.

Evidential measuring of breath alcohol: Approval of breath alcohol measuring devices

On October 1, 2016, an evidential breath alcohol sample will be introduced in Switzerland. One year earlier METAS had already examined and approved the first breath alcohol measuring device in accordance with national requirements.

Parliament adopted the action programme for greater safety in road-traffic (Via Sicura) on June 2012. In the summer of 2015, after a prolonged preparation period, the Federal Council implemented the Via Sicura-measure “evidential breath sample” on 1 October 2016. The evidential breath sample will as a general rule replace the blood sample which is currently being used to determine the state of drunkenness. METAS was also involved in the preparations for the introduction. On March 1, 2015, the totally revised Ordinance of the FDJP regarding breath alcohol measuring instruments came into force. This newly distinguishes between three categories of measuring instruments: the already regulated breath test devices, the breathalysers and alcohol immobilisers. The date of introduction of the immobilisers is not yet determined.

Breath alcohol test devices and breathalysers

Breath alcohol test devices determine the alcohol concentration in the breath via a measurement method. The measured concentration in mg ethanol per litre of exhaled air (mg/l) must currently be converted in a blood alcohol content and then displayed. This conversion to a blood alcohol content will be omitted as of October 1, 2016; Breath alcohol testing devices may continue to be used in the range of 0.25 mg/l to 0.39 mg/l.

Breathalysers, however, determine the alcohol concentration in human breath under controlled sampling conditions and in redundant type. In general, the redundancy is achieved via two different measurement methods. The displayed results are applicable as reliable evidence in the range of 0 mg/l to 2 mg/l and can be used as the basis for a fine or conviction.



Approval of breath alcohol measuring devices

Breath alcohol measuring devices may only be placed on the market in Switzerland following the regular approval and initial verification by METAS. The basis for approval is a successful type examination. Internationally harmonised technical standards are referenced to the fullest extent possible with design type requirements. With breath alcohol test equipment this is therefore EN 15964 and with alcohol breath measuring devices, Recommendation R126 of the International Organization of Legal Metrology (OIML), which is supplemented with specific Swiss requirements.



At the end of September 2015 METAS was able to approve the first breath analyser. Another breath analyser with a second design type was approved in February 2016. Two other manufacturers are also planning to introduce their products for the Swiss market.



Simulating human breath in the laboratory:
Means for testing of breath alcohol measuring devices.

Regulating measurement: Legislation in the field of metrology

Regulation revisions modernised the rules on measuring instruments for electrical energy and services. Furthermore, it was ensured that in the field of measuring instruments, the Swiss provisions remained equivalent to those of the European Union.

METAS contributes in the preparation of decrees on metrology. The task is to ensure that the requirements are technically and legally up to date. In 2015 regulation revisions were therefore implemented in two areas.

Measuring instruments for electrical energy and power

On 1 October 2015, the completely revised Ordinance of the FDJP of 26 August 2015 on measuring instruments for electrical energy and power (EMmV) replaced the same regulation from the year of 2006.

In 2006 Switzerland adopted EU legislation for a category of measuring instruments for electrical energy and power: for active energy meters. In addition, other measuring instruments are regulated nationally. In recent years, it was found that the provisions governing the national regulated measuring instruments in part no longer meet today's technical realities. For example, a number of the functions of electricity meters were not clearly defined. With the revision these deficiencies have been rectified and other innovations introduced.

The rules are designed so that they will not interfere with the future introduction of so-called smart meters. The revision therefore contributes to achieving the objectives of the Energy Strategy 2050 of the Confederation, currently the subject of parliamentary debate.

New EU regulatory framework

As part of their bilateral agreements, Switzerland and the EU mutually recognise each other's conformity assessments of various categories of measuring instruments. This helps to break down trade barriers.

As of 20 April 2016, new guidelines for several product areas shall apply in the EU, including measuring instruments. With these guidelines the EU implements its new regulatory framework for the marketing of products. In November 2015, the Federal Council and the FDJP resolved on a number of regulatory changes necessary to ensure that the Swiss regulations remain equivalent with those of the EU in the future.





The revised provisions of the Measuring Instruments Ordinance and the Ordinance of the FDJP on non-automatic weighing instruments enter into force on 20 April 2016. These contain clearer definitions, a more refined control of the responsibilities of manufacturers, importers and distributors, as well as unified rules regarding the conformity assessment bodies.



Adapted to technical conditions requirements:
Testing of electricity meters.

Making measuring possible: employees are crucial

METAS is an attractive place to work. This is above all proven by the result of the employee survey. In addition to this survey, a customer survey was also conducted. METAS received a consistently high rating in terms of overall satisfaction from its customers; METAS employees are valued very highly by customers.

METAS is keen to be an attractive employer and training location. This first and foremost includes a demanding and challenging job in a professionally stimulating environment. Equally indispensable are attractive employment conditions that enable work and family to be reconciled and corresponding flexible solutions. The size of METAS allows individual needs to be met. It provides, for example, different working time models or, depending on the activity, the possibility of telecommuting days at home. A stimulating working environment and good employment conditions are the basis for satisfied and motivated employees. These in turn are the key to business success. Studies repeatedly show that motivation and job satisfaction directly and positively affect the motivation, loyalty and customer orientation of employees.

Customers appreciate the METAS employees

In summer METAS conducted a customer survey with its Swiss customers. The survey was similar to that conducted in 2012 in order to ensure comparability. A specialised external company was responsible for the implementation and evaluation of the survey. The return of the questionnaires was 32.5 percent. The overall customer satisfaction with the METAS services is unchanged, remaining as high as before. The employees are very highly rated by the customers: Our employees are the best rated quality aspect of METAS. The results of the customer survey reflects that of the employee survey, which was carried out in the summer. The balance is extremely positive in both cases.



High job satisfaction

The employees survey was carried out by an external and independent company. With a satisfactory return rate of 84 percent the results of this survey provide a meaningful data basis. The result can be seen: It is excellent. This is true both in itself as well as in comparison to a previous survey conducted in 2011, or in comparison to other units of the federal administration.



Services on the way to the customer: Shipping devices.

Particularly outstanding were the results in the areas of job satisfaction and commitment, in which the values count amongst the highest in the entire federal environment. Job satisfaction is a statement about the subjective assessment of individual work situations. Different factors such as work content, development prospects or, for example, co-operation and working environment all play a role. Together with the so-called commitment, a measure of the closeness of the employees with their employer and their sense of belonging, job satisfaction influences the targeted oriented behaviour of the employees.

Based on the survey, improvements in the slightly weaker-rated issues such as knowledge transfer or workflows could be identified. These will be critically scrutinised in the next few months and measures will be developed in order to achieve improvements.

Maintaining such a good result in the future will be a major challenge.

METAS is committed to being an attractive training location. It offers six different apprenticeships in the areas laboratory, electronics, information technology, engineering and commerce as well as university internships.

Finances

METAS ended the 2015 financial year with a profit of 5.6 million Swiss francs. Expenditures amounted to 40.7 million Swiss francs and revenues (including payments received) to 46.3 million Swiss francs.

METAS's reporting is carried out in accordance with the International Public Sector Accounting Standards (IPSAS) and complies with statutory requirements. This accounting standard was chosen in close consultation with the auditors, the Swiss Federal Audit Office.

Balance sheet

(in TCHF)	31.12.2015	31.12.2014
Assets		
Cash	12 514	8 995
Trade receivables	3 051	3 265
Receivables for research projects	1 910	2 152
Other receivables	67	158
Prepaid expenses and accrued income	916	698
Working capital	18 458	15 268
Tangible fixed assets	20 641	20 463
Intangible fixed assets	1 539	1 295
Fixed assets	22 180	21 758
Total assets	40 638	37 026
Liabilities and equity		
Current liabilities on trade accounts payable	1 043	702
Liabilities in respect of research projects	2 702	2 852
Other liabilities	982	697
Accrued expenses and deferred income	130	395
Short-term provisions	663	610
Short-term borrowed capital	5 520	5 256
Provisions for pension fund liabilities	30 417	32 603
Provisions for service awards	1 288	1 318
Long-term borrowed capital	31 705	33 921
Net loss	-2 151	-6 589
Profit	5 564	4 438
Equity capital	3 413	-2 151
Total liabilities and equity	40 638	37 026

Profit and loss account

(in TCHF)	2015 1.1.2015–31.12.2015	2014 1.1.2014–31.12.2014
Net revenue	46 258	45 593
Profit from sale of fixed assets	23	0
Expenditure on materials and third-party services	–886	–743
Personnel expenses	–25 068	–24 998
Other operating expenses	–11 112	–11 543
Depreciation	–3 403	–3 796
Operating expenses	–39 583	–40 337
Financial revenue	5	45
Financial expense	–253	–120
Financial result	–248	–75
Profit	5 564	4 438

In the reporting year, METAS was able to finance 51.1 percent of its activities (preceding year 47.1 percent) out of its own resources. The following means contributed to the self-financing level: fees, payments for taking over other tasks and external funds.

The auditors have confirmed without reservation that the accounts have been properly prepared.

The detailed, IPSAS-compliant annual accounts can be downloaded on the Internet at www.metas.ch or requested from METAS.

Telling the measurement story: METAS publications and papers

The research and development work is also reflected in publications and papers authored or presented to a live audience by METAS researchers.

In 2015, METAS personnel again presented the results of their research and development work at symposiums, conferences and in scientific publications. They collaborated in specialist organisations and committees at national and international levels, contributing their know-how and experience there. They made metrology accessible to a wide audience including those beyond the immediate specialist group and were actively involved in courses for students at universities.

Measurement, a constantly recurring theme

METAS personnel authored over 30 publications and presented more than 40 papers in 2015. A series of lectures was also given in the course of events at METAS itself.

In 2015, METAS published two issues of “METinfo”, the technical journal for metrology. The articles are as a general rule written by METAS personnel. Several “METinfo” articles were taken up by trade journals from different areas.

Raising enthusiasm for measuring

METAS participated in the “Research live” anniversary programme of the Swiss Academy of Natural Sciences (200 years ScNat) in Bern. On the occasion of the Year of the light, the optics laboratory, in collaboration with the Schweizer Licht Gesellschaft (SLG), held a seminar on light measurement on November 12, 2015. The event met with great interest and was quickly sold out. Like last year, METAS participated in the “Girls – Technology – Lets go” programme during the national future day, which took place on 12 November, 2015.

Alongside these events, approximately 20 visits were carried out for groups of over a total 500 people. Visits enable a direct insight into the activities of METAS and, above all, in the work in the laboratories and the development of METAS measuring devices. These in turn impart a strong and lasting impression and help in awakening understanding of our activities.

Publications and Papers

The list below provides an overview of the most important publications authored by METAS personnel and the papers presented by them. When giving the authors' names, those of the METAS employees are shown in bold.

Publications: Technical articles

H. Baumann, F. Pythoud, D. Blas, S. Sibiryakov, A. Eichenberger and E. E. Klingelé: *Experimental assessment of the speed of light perturbation in free-fall absolute gravimeters*. Metrologia 52, 2015, pp. 635–645.

H. Bissig et al.: *Primary standards for measuring flow rates from 100 nl/min to 1 ml/min – gravimetric principle*. Biomed. Eng.-Biomed. Tech. 60, 2015, pp. 301–316.

H. Bissig, M. Tschannen, M. de Huu: *Micro-flow facility for traceability in steady and pulsating flow*. Flow Measurement and Instrumentation 44, 2015, pp. 34–42.

J. Hoffmann, M. Wollensack, J. Rufenacht, M. Zeier: *Extended S-parameters for imperfect test ports*. Metrologia 52, 2015, pp. 121–129.

C. Gomà, B. Hofstetter-Boillat, S. Safai, S. Vörös: *Experimental validation of beam quality correction factors for proton beams*. Phys. Med. Biol. 60, 2015, pp. 3207–3216.

A. Küng, A. Nicolet, F. Meli: *Study of wear of diamond-coated probe tips when scanning on different materials*. Meas. Sci. Technol. 26, 2015, 084005 (7 p.).

D. Lachat: *Average Speed Control*. Bulletin OIML 56 (1), 2015, pp. 28–31.

K. Marti, S. Russi, P. Fuchs: *Traceability of mass II: a study of procedures and materials*. Metrologia 52, 2015, pp. 89–103.

S. Davidson, J. Verry, K. Marti: *Practical requirements for the successful implementation and subsequent dissemination of the redefined kilogram*. Vacuum 120, 2015, pp. 139–146.

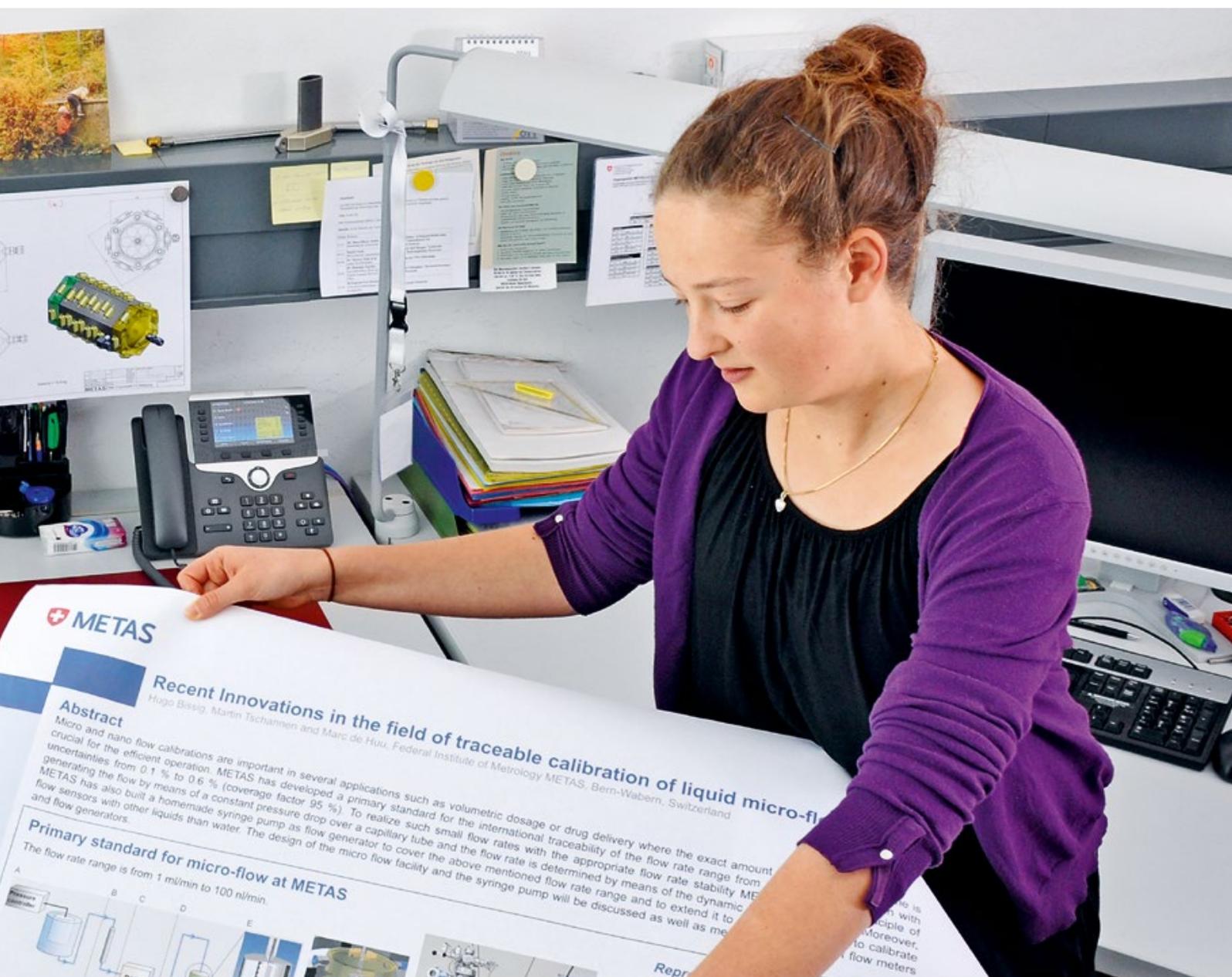


A. Mindel, S. Perrin, A. Marti: *Pektolytische Enzyme und Methanolbildung in Obstmaischen*. Schweizer Zeitschrift für Obst- und Weinbau (SZOW), 2015, 2, pp. 9–12.

C. Pascale, B. Niederhauser: *Herstellung rückführbarer Kalibriergasgemische mittels gravimetrischer Messung von Permeationsprozessen*. Rubotherm, FluiPROP Application note, 2015 (2p.).

C. Pascale, B. Niederhauser: *Preparation of SI Traceable Calibration Gases by Gravimetric Measurement of a Permeation Process*. Rubotherm, FluiPROP Application note, 2015 (2p.).

R. Thalmann, D. Kündig: *Which diameter matters? MacroScale. Recent developments in traceable dimensional measurements 2015*, 810.20150325D (10p.).
V. Mudronja, V. Šimunovic, B. Acko, M. Matus, E. Bánréti, D. István, R. Thalmann et al.: *Final report on EURAMET.L-S21: Supplementary comparison of parallel thread gauges*. Metrologia 52, 2015, Tech. Suppl., 04003.



Preparing papers: a poster in print.

M. McEwen, P. Sharpe, S. Vörös: *Evaluation of alanine as a reference dosimeter for therapy level dose comparisons in megavoltage electron beams*. Metrologia 52, 2015, pp. 272–279.

C. Kessler, D. T. Burns, S. Vörös, B. Hofstetter-Boilat: *Key comparison BIPM.RI(1)-K4 of the absorbed dose to water standards of the METAS, Switzerland and the BIPM in ^{60}Co gamma radiation*. Metrologia 52, 2015, Tech. Suppl., 06002.

M. Zeier: *Messunsicherheiten in der Vektornetzwerkanalyse. Die neue Richtlinie EURAMET cg-12. Messunsicherheit praxisingerecht bestimmen*, VDI Berichte 2269, 2015, pp. 29–38.

Publications: Conference proceedings

H. Baumann, A. L. Eichenberger, B. Jeckelmann et al.: *The Metas Watt Balance Mark II : First Results*. Proceedings XXI IMEKO World Congress «Measurement in Research and Industry», Prag, August 30 to September 4, 2015.

H. Bissig, M. Tschannen, M. de Huu: *Primary Standard in Micro Flow for Traceability in Steady and Pulsating Flow Regime*. 9th ISFFM (International Symposium of Fluid Flow Measurements) Arlington, Virginia, April 14 to 17, 2015, (7p.).

Ch. Bock: *Décision C-423/13 : 4^{ème} décision de la Cour de Justice de l'Union Européenne sur la directive sur les instruments de mesure et les dispositifs intelligents*. 17th International Congress of Metrology, 2015, 16002, pp. 1–5.

Ch. Bock: *Der Umgang des Staates mit «technischen» Normen*. F. Uhlmann (Hrsg.), Private Normen und staatliches Recht. 14. Jahrestagung des Zentrums für Rechtsetzungslehre. Zürich/St. Gallen: Dike, 2015, pp. 21–59.

J.-P. Braun, S. Siegenthaler: *The calibration of static and dynamic performances of PMUs*. 17th International Congress of Metrology, 2015, 12002, pp. 1–6.

D. Corminboeuf: *Calibration of bridge standard for strain gauge bridge amplifier*. 17th International Congress of Metrology, 2015, 04004, pp. 1–5.

S. Dash, F. Pythoud et al.: *Traceable Power Measurement of LTE Signals*. 17th International Congress of Metrology, 2015, 12005, pp. 1–6.

J. Hoffmann, M. Wollensack, J. Ruefenacht, M. Zeier: *Comparison of Methods for Measurement of Equivalent Source Match*. Proceedings of the 45th European Microwave Conference, 2015, pp. 730–733.

M. de Huu, B. Wüthrich: *The Hydrometric Calibration Facility from METAS: A Primary Standard for Liquid Flow Speed.* 9th ISFFM (International Symposium of Fluid Flow Measurements) Arlington, Virginia, April 14 to 17, 2015, (7p.).

F. Meli: *Economic high resolution fringe counting for heterodyne interferometers using FPGA technology.* MacroScale. Recent developments in traceable dimensional measurements 2015, 810.20150325E.

P. Richard: *The redefinition of the SI in 2018 and the present status for the kilogram.* Keynote speaker. Proceedings XXI IMEKO World Congress «Measurement in Research and Industry», Prag, August 30 to September 4, 2015.

H.-P. Vaterlaus, X. Li: *Control of quantity of prepackages: New statistical multistep sampling procedure.* 17th International Congress of Metrology, 2015, 02013, pp. 1–3.

Papers (without publicised proceedings)

H. Baumann: *Status of the METAS Watt balance.* CCM WGR-kg, BIPM, Paris, 24.2.2015.

H. Bissig: *Calibration Services for Health Care.* MeDD Symposium, Utrecht, the Netherlands, 22.5.2015.

J.-P. Braun: *The metrological characterisation of PMUs.* IEEE Italy, Section school on future energy systems, Trento, 27.1.2015.

J.-P. Braun: *The calibration of static and dynamic performances of PMUs.* CIM Paris, 24.9.2015.

J.-P. Braun: *Metrological characterisation of PMUs.* Workshop on PMU metrological requirement, Quality infrastructure for renewable energy sources & energy efficiency in Latin America and the Caribbean, Bent Goncalvez, Rio Grande do Sul, 27.11.2015.

J.-P. Braun: *PMU in distribution networks.* Workshop on PMU metrological requirement, Quality infrastructure for renewable energy sources & energy efficiency in Latin America and the Caribbean, Bent Goncalvez, Rio Grande do Sul, 27.11.2015.

D. Corminboeuf: *Calibration of bridge standards for strain gauge bridge amplifiers.* CIM Paris, 22.9.2015.

S. Dash: *Traceable Power Measurement of LTE Signals.* 17th International Congress of Metrology, 2015, Paris, 24.9.2015.

J. Hoffmann: *Nearfield Scanning Microwave Microscopes.* EURAMET TCEM SC-RF&MW Meeting, Istanbul, 14.4.2015.

J. Hoffmann: *2.92 mm Offset Short Calibration.* Keysight Metrology Workshop, Istanbul, 16.4.2015.

J. Hoffmann: *Connector Effect and Ripple Method.* Keysight Metrology Workshop, Istanbul, 16.4.2015.

J. Hoffmann: *Comparison of Source Match Measurements.* European ANAMET Seminar, METAS, Wabern, 3.6.2015.

J. Hoffmann: *Comparison of Source Match Measurements.* European Microwave Conference, Paris, 9.9.2015.

J. Hoffmann: *1.0 mm Offset Short Calibration.* European ANAMET Seminar, Paris, 12.12.2015.

A. Küng: *Friction and wear of diamond coated microprobes.* euspen, Micro/Nano Manufacturing Workshop, NPL, Teddington, 25.11.2015.

D. Leuenberger et al.: *On Development and Characterisation of a Portable Standard Gas Generator.* GAS 2015, Rotterdam, 9.6.2015. [Best Poster Award]

K. Marti: *A study of materials and procedures for future mass standards: latest results at METAS.* Working Group Mass, BIPM, Paris, 24.2.2015.

F. Meli: *Virtual model of a μ -CMM.* Workshop on methods of uncertainty determination for computed tomography in dimensional metrology, FMT-FAU Erlangen, 28.1.2015.

F. Meli: *Intercomparison of reference materials.* Workshop on metrological characterization of microvesicles, VSL, Delft, 28.5.2015.

F. Meli: *Virtual micro-CMM: Application to complex parameter based shapes.* euspen, Micro/Nano Manufacturing Workshop, NPL, Teddington, 25.11.2015.

C. Pascale: *Metrology at METAS in support for Atmospheric Science.* Meeting GAW-CH Landesauschuss, Zürich-Kloten, 13.5.2015.

C. Pascale: *New activities in the METAS Gas Laboratory for Essential Climate Variables.* GAS 2015, Rotterdam, 11.6.2015.

B. Niederhauser: *EMRP ENV55 MetNH₃: Towards a Consistent Metrological Infrastructure for Ammonia Measurements.* GAS 2015, Rotterdam, 11.6.2015.

F. Pythoud: *Introduction to EMC.* EMV-Fachtagung, Kloten, 21.1.2015.

P. Richard: *Revision of the International System of Units (SI) and consequences for the kilogram.* PTB Kolloquium, Braunschweig, 20.1.2015.

P. Richard: *The present situation with the CCM roadmap for a redefinition of the kilogram in 2018.* Seminar on the redefinition of the kilogram, Xi'an, China, 15.7.2015.

P. Richard: *The CCM roadmap for a redefinition of the kilogram in 2018.* 2015 NCSL International Workshop & Symposium «Measurement Science and the Quality of Life», Grapevine, Texas, 22.7.2015.

J. Rüfenacht: *Practical Hints: Splitter Characterization.* European ANAMET Seminar, METAS, Wabern, 3.6.2015.

E. Tas: *A new Conducted Immunity Test Device for Interlaboratory Comparison.* EMC Europe, Dresden, 20.8.2015.

R. Thalmann: *Welcher Durchmesser passt? 6.* Swissmem Seminar «Dimensionelle Messtechnik», Winterthur, 10.3.2015.

R. Thalmann: *METAS-SAS: Organisation, Aufgaben.* 6. Versammlung Swissmem-Fachgruppe «Dimensionelle Messtechnik», Egerkingen, 15.4.2015.

R. Thalmann: *Principles and Applications of Dimensional Metrology.* IGSM Summerschool on Metrology, Drübeck, 25.8.2015.

R. Thalmann: *Präzisionskoordinatenmesstechnik – Neue Entwicklungen zur Rückführung von Messergebnissen.* Fachtagung Produktionsmesstechnik, NTB Buchs, 3.9.2015.

R. Thalmann: *E-Zertifikate und digitale Signatur.* EUROLAB-CH / SNV Seminar Dokumentenmanagement im Labor, Winterthur, 18.11.2015.

K. Vasilatou: *Heterogeneously nucleated particles as a reference calibration aerosol according to ISO 27891.* Particulate Workshop (GAWG), BIPM, Paris, 15.4.2015.

M. Wollensack: *VNA Tools: Splitter Characterization.* European ANAMET Seminar, METAS, Wabern, 3.6.2015.

M. Zeier: *ECU Stability Tests.* EURAMET TCEM SC-RF&MW Meeting, Istanbul, 14.4.2015.

M. Zeier: *A simplified method of VNA uncertainty estimation.* EURAMET TCEM SC-RF&MW Meeting, Istanbul, 14.4.2015.

M. Zeier: *The revision of EURAMET Guide cg-12.* EURAMET TCEM Meeting, Sarajewo, 15.10.2015.

M. Zeier: *Measurement Uncertainties in Vector Network Analysis – The New Guideline EURAMET cg-12.* VDI Fachtagung Messunsicherheit 2015, Braunschweig, 17.11.2015.

