TÜBİTAK

UME

2016 ANNUAL REPORT

TÜBİTAK NATIONAL METROLOGY INSTITUTE

2016
ANNUAL REPORT

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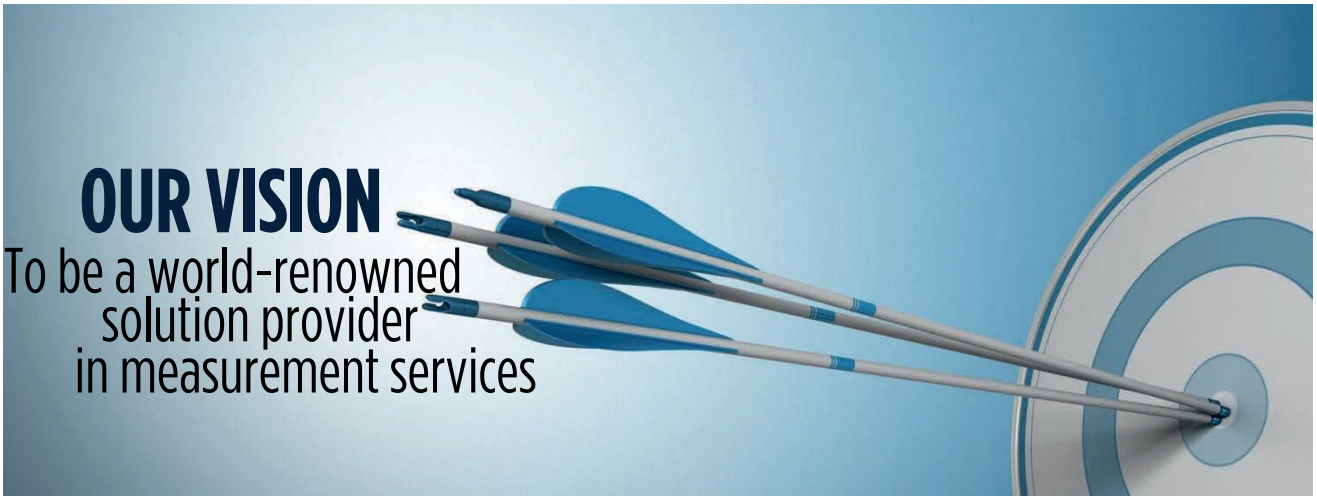


FOREWORD

Dear Stakeholders,

We’re pleased to present you our annual report in which you will find detailed information on the activities undertaken by the TÜBİTAK National Metrology Institute in 2016.

As in years past, TÜBİTAK UME continued its activities aimed at the development and maintenance of national measurement standards and dissemination of measurement traceability. In addition to these core activates, TÜBİTAK UME maintained involvement in international R&D projects and efforts to develop solutions to challenges in industrial measurements.

TÜBİTAK UME carried out work on a total of 56 R&D projects in 2016. Of these, 38 were co-funded by the European Commission through EMRP and EMPIR, 2 were funded by the Ministry of Development, 6 were TÜBİTAK funded and 10 were directly financed by customers (7 from within Turkey and 3 international.)

Two new Memorandums of Understanding were signed and two were renewed as part of our effort to forge closer relations with other national metrology institutes in our geographical areas of interest; the Middle East, the Balkans, Central Asia, and Africa.

In 2016, work began on 14 EMPIR projects that accepted for funding in the 2015 call cycle, while 9 EMRP projects were completed within the year.

TÜBİTAK UME became the first producer of certified reference materials accredited according to ISO Guide 34 in Turkey by the decision of TÜRKAK dated December 21, 2016.

Two applications for national patents on measurement systems designed by TÜBİTAK UME were submitted within the year. These applications are now under consideration.

Our goal is to be counted among the most advanced metrology institutes in Europe, and the world, by the year 2023 as a result of our innovative scientific and technological activities.

Dr. Mustafa ÇETİNTAŞ
Director
TÜBİTAK UME

CHRONOLOGY

1875	The Meter Convention was signed on May 20, 1875.
1931	Law No. 1782 on 'Weights and Measures' was signed and usage of the metric system became mandatory on March 26, 1931.
1981	TÜBİTAK was assigned the responsibility of establishing a national metrology center by the Council of Ministers.
1984	The Council of Ministers' decision on the establishment of a primary level "Industrial Metrology and Calibration Laboratory" was published in the Official Gazette.
1986	The 'National Physics and Technical Measurement Standards Center' began operations in 226 m^2 of space.
1992	The name of the institution was changed to the "National Metrology Institute" (UME)
1994	TÜBİTAK UME moved its operations to a new building with an indoor area of 7.500 m^2.
1999	TÜBİTAK UME signed the CIPM Mutual Recognition Agreement (MRA).

2003	TÜBİTAK UME expanded with completion of a new complex consisting of 4 blocks with 28.650 m^2 of space.
2006	TÜBİTAK Science Board designated TÜBİTAK UME as a Research and Development Entity.
2007	TÜBİTAK UME was among the founding members of EURAMET.

R&D ACTIVITIES

Activities related to the realization of primary level measurement standards remain the highest priority at TÜBİTAK UME in line with its institutional mission.

However, TÜBİTAK UME also increased its research activity in 2016. It was active in a total of 56 separate R&D projects, including those continuing from previous years. Of these projects, 38 were co-funded through the European Metrology Research Programme (EMRP) and its successor, the European Metrology Programme for Innovation and Research (EMPIR), 2 were supported by the Ministry of Development, 6 were funded by TÜBİTAK and 10 were contracted by customers in Turkey (7) and abroad (3).

Within EMPIR, TÜBİTAK UME initiated work in 14 joint research projects that were funded in the 2015 call cycle, while work on 9 EMRP projects was concluded.

ONGOING INTERNALLY FUNDED PROJECTS

LABORATORY	PROJECT
Gas Metrology	Preparation and Certification of Primary Reference Gas Mixtures of Carbon Monoxide and Carbon Dioxide In Nitrogen
Gas Metrology	Preparation and Certification of Primary Reference Gas Mixtures for Natural Gas Analysis
Bioanalysis	Production of Reference Material for Identification of Meat Species
Bioanalysis	Production of Reference Material of HbA1c
Temperature	Construction of Eutectic and Fixed-Points for Thermocouple Calibration
Dimensional	Establishment of Ellipsometry and Skaterometry Methods and Measurement Systems
Time/Frequency	Improvement of National Time Scale System
Time/Frequency	Photonically Based Rb Atomic Clocks And Rb Atomic Frequency Standard Generation
Impedance	Establishment of a Terminal Coaxial Digital Impedance Comparison System
Magnetics	Atomic Spin Gyroscope Cell Preparation and Characterization
Acoustics	Establishment of a Medical Metrology Research Laboratory
Time/Frequency and Wavelength	First generation UME Watt Balance set up
Optic	Establishment of High Resolution Spectroradiometer System and Generation of Traceability Chain for Radiation
Electrochemistry	Establishment of Primary Level Electrolytic Conductivity Measurement System

COMPLETED INTERNALLY FUNDED PROJECTS

LABORATORY	PROJECT
Reference Materials	Dried Fig Certified Reference Material Production and Certification
Reference Materials	Trace Elements in Hazelnuts Certified Reference Material Production and Certification
Reference Materials	25-OH Vitamin D2/D3 in Lyophilized Serum Certified Reference Material Production Certification
Reference Materials	Production of Carbon Isotope Certified Reference Materials and Certification of Delta Values
Reference Materials	Production of Certified Reference Buffers for Ph Measurement and Calibrations
Inorganic Chemistry	Production of Waste Water Certified Reference Material
Volume, Density and Viscosity	The Automatization of the Primary Level Hydrometer Calibration System
High Voltage	Construction of Primer Lightning and Switching Impulse Measurement System
High Voltage	Construction of Primer Partial Discharge (PD) Measurement System

ONGOING EXTERNALLY FUNDED INTERNATIONAL PROJECTS

LABORATORY	PROJECT
Organic Chemistry	Development and Production of Fuel Marker System and On-Site Marker Control Devices for OPET Company
Organic Chemistry	Production and Continuous Update of National Marker System for Fuels (EMRA)
All Laboratories	SASO/NMCC Collaboration and Consulting for General Metrology
All Laboratories	SASO/NMCC Establishment of Laboratories, Development and Consultancy Services Program
Time/Frequency and Wavelength	SASO / NMCC Time and Frequency Laboratory Improvement Consultancy Services Program
Power and Energy	Establishment of a Calibration Laboratory for TEİAŞ
Fluid Flow	Development of Pitot Tube Speed and Altitude Measurement System
Organic Chemistry	Production and Development of Diesel Performance Additive for TP (Turkish Petroleum)

COMPLETED EXTERNALLY FUNDED INTERNATIONAL PROJECTS

LABORATORY	PROJECT
Reference Materials	CRM Production for Eti Mine Operations and Post-Certification Monitoring Activities
Organic Chemistry	Production and Continuous Update of the National Marker System for Fuels (EMRA)
Organic Chemistry	Development and Production of Diesel Performance Additive and Company Marker for ALPET Company

ONGOING TÜBİTAK PROJECTS

LABORATORY	PROJECT
Time/Frequency and Wavelength	Development of High Power Laser System
Reference Materials	Development and Certification of Amino Acid and Organic Acid Quality Control and Certified Reference Materials for Routine Clinical Laboratory Analysis and Newborn Screening
Bioanalysis	Korea-Turkey Collaboration On Development of An International Standard System for Measurement of Gene Methylation

COMPLETED TÜBİTAK PROJECTS

LABORATORY	PROJECT
Acoustics - Medical Metrology	Improvement of Classroom Acoustics for Hearing Impaired Students
Magnetics	Synthesis of Radar Absorbing Materials Using Boron Addition and Their Characterization
Magnetics	Development of Rapidly Quenched Magnetic Alloys for Low DC Magnetic Field Detection

ONGOING EMRP & EMPIR PROJECTS

LABORATORY	PROJECT
Dimensional	EU-ASEAN S&T Cooperation to Jointly Tackle Societal Challenges (SEA-EU-NET 2)
Acoustics	Metrology for Modern Hearing Assessment and Protecting Public Health from Emerging Noise Sources (Ears II)
Impedance	Quantum Realisation of the SI Ampere (e-SI-Amp)
Time/Frequency	Optical Clocks with 1E-18 Uncertainty (OC18)
High Voltage	Techniques for Ultra-High Voltage and Very Fast Transients (UHV)
Bioanalysis	Novel Materials and Methods for The Detection, Traceable Monitoring and Evaluation of Antimicrobial Resistance (AntiMicroResist)
Dimensional	Reference Algorithms and Metrology on Aspherical and Freeform Lenses (FreeFORM)
Power and Energy	Traceability Routes for Electrical Power Quality Measurements (TracePQM)
Temperature	Expansion of European Research Capabilities in Humidity Measurement (HUMEA)
RF and Microwave	Development of RF and Microwave Metrology Capability (RFMicrowave)
Temperature	Implementing the New Kelvin 2 (InK 2)
Magnetics	Nano-Scale Traceable Magnetic Field Measurements (NanoMag)
Time/Frequency	Optical Frequency Transfer - A European Network (OFTEN)
Voltage	Waveform Metrology Based on Spectrally Pure Josephson Voltages (QuADC)
Inorganic Chemistry	Role of Metals and Metal Containing Biomolecules in Neurodegenerative Diseases such as Alzheimer's Disease (ReMiND)
Gas Metrology	Metrology for High-Impact Greenhouse Gases (HIGHGAS)
Gas Metrology	Metrology for Biogas (BIOGAS)
Power and Energy	Sensor Network Metrology for the Determination of Electrical Grid Characteristics (GridSens)
Power and Energy	Non-Conventional Voltage and Current Sensors for Future Power Grids (FutureGrid)
Optic	Metrology for Efficient and Safe Innovative Lighting (MESAiL)
Optic	Metrology for III-V Materials Based High Efficiency Multi-Junctions Solar Cells (SolCell)
Temperature	Metrology for Essential Climate Variables (MeteoMet2)
Organic Chemistry	Metrology for VOC Indicators for Air Pollution and Climate Change (KEY-VOCs)
Organic Chemistry	Traceability for Mercury Measurements (MeTra)
Mass	Traceable Calibration of Dynamic Weighing Instruments Operating in the Dynamic Mode (AWICal)
Reference Material	Matrix Reference Materials for Environmental Analysis (ENVCRM)
Temperature	Developing Traceable Capabilities in Thermal Metrology (Eura-Thermal)
Voltage	Towards The Propagation of AC Quantum Voltage Standards (ACQ-PRO)
Pressure	Industrial Standards in The Intermediate Pressure-To-Vacuum Range (pres2vac)

COMPLETED EMRP PROJECTS

LABORATORY	PROJECT
Temperature	Metrology for Moisture in Materials (METefnet)
Voltage	Quantum Standard for Sampled Electrical Measurements (Q-WAVE)
Acoustics	Realisation, Dissemination and Application of the Unit Watt in Airborne Sound (SoundPwr)
Impedance	Automated Impedance Metrology Extending the Quantum Toolbox for Electricity (AIM QuTE)
Electromagnetic	Improved EMC Test Methods in Industrial Environments (EMC)
Bioanalysis	Traceability for Biologically Relevant Molecules and Entities (Bio-SITrace)
Force	Force Traceability Within The Meganewton Range (Force)
Time/Frequency and Wavelength	Compact and High-Performing Microwave Clocks for Industrial Applications (Mclocks)
Dimensional	Angle Metrology (Angles)

NATIONAL MEASUREMENT STANDARDS

TÜBİTAK UME continued to fulfill the demands of its local and foreign customers for calibration, training and consultancy services in 2016.

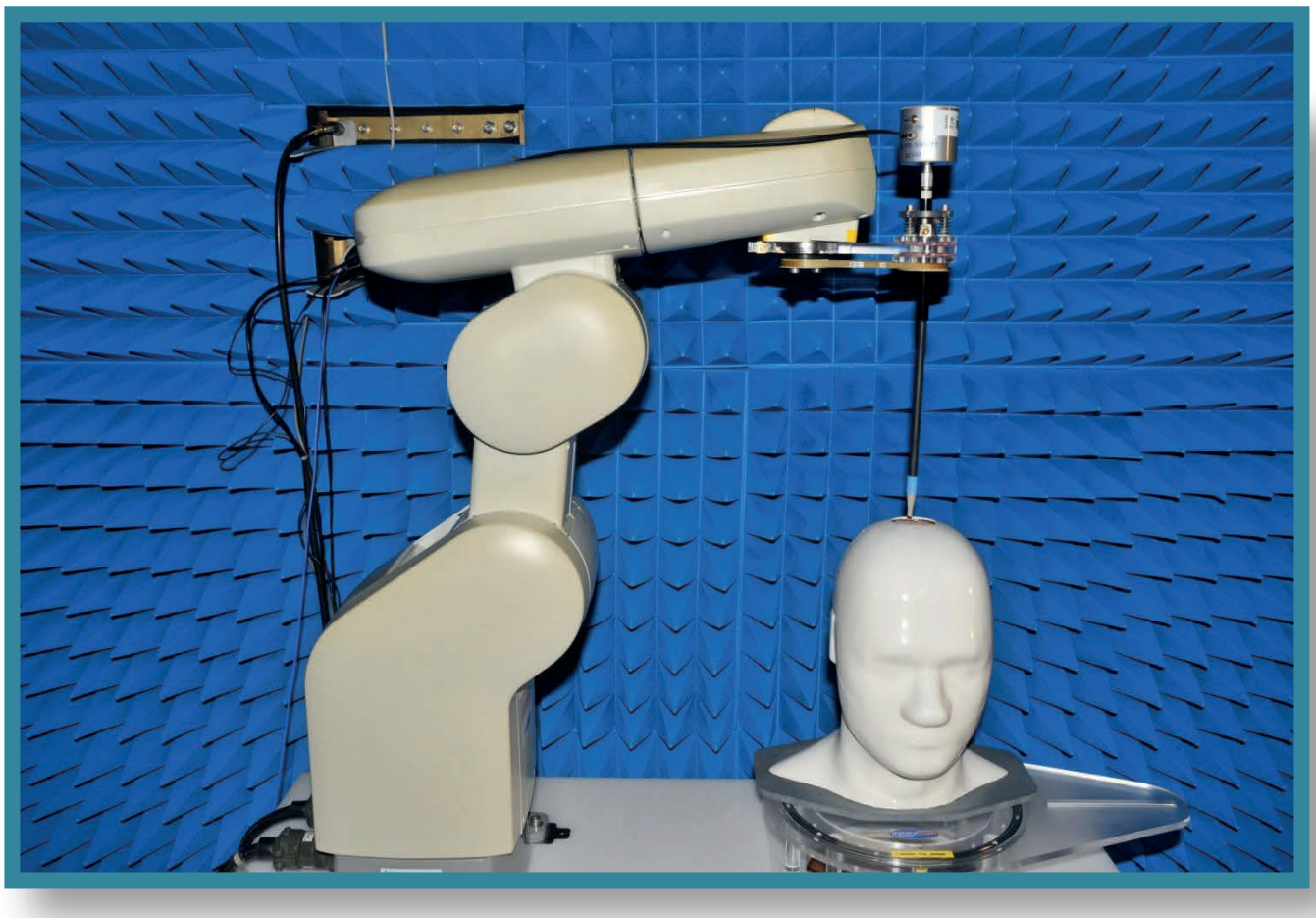
In 2016, TÜBİTAK UME provided 611 types of test and calibration services with its established infrastructure of 120 different primary level standards that encompass 111 different measurement quantities.

TÜBİTAK UME developed 19 new measurement techniques and added 7 measurement quantities to its range of measurement capabilities.

TÜBİTAK UME produced 35 new references / devices / standards in 2016 for use as national measurement reference standards and/or standard measurement systems.

NEW MEASUREMENT QUANTITIES

LABORATORY	MEASUREMENT QUANTITY
RF and Microwave	Measuring the SAR Value of Mobile Cell Phones
Acoustics	Secondary Level Shock Calibration System for Accelerometers
Power and Energy	Harmonic Voltage
Power and Energy	Harmonic Current
Power and Energy	Flicker
Power and Energy	Loss of Transformer
Fluid Flow	Gas Mass Flow



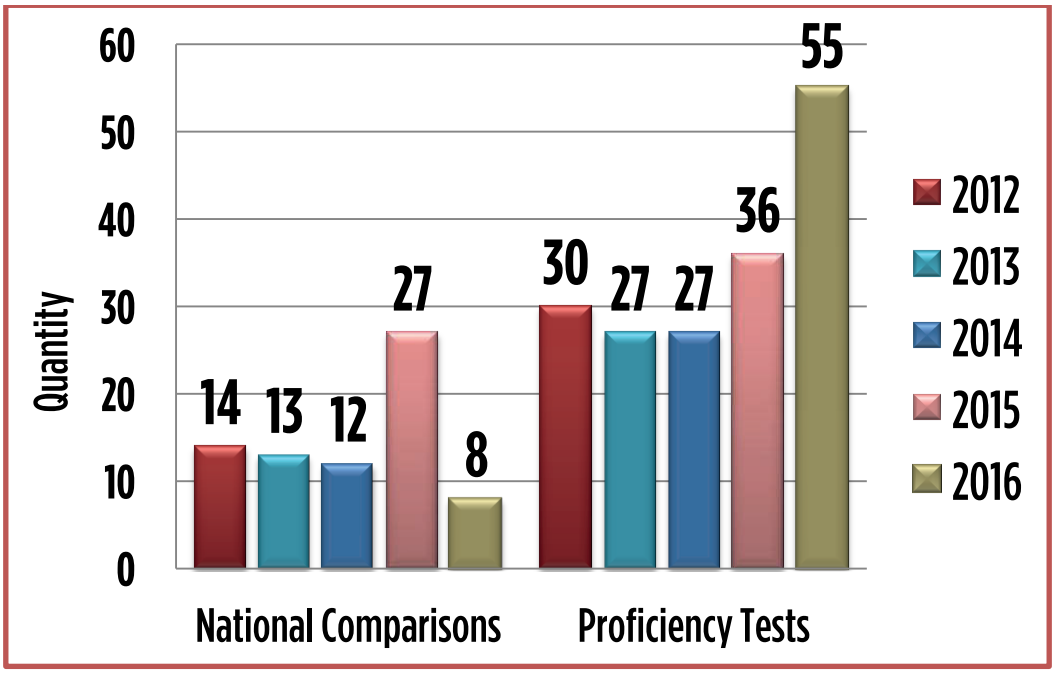
NEW MEASUREMENT TECHNIQUES

LABORATORY	MEASUREMENT TECHNIQUE
RF and Microwave	Measurement of SAR
Gas Metrology	Determination of Oxygen in Air
Power and Energy	Calibration Technique for Transformer Loss Measurement System
Organic Chemistry	Determination of Urea and Uric Acid in Serum
Organic Chemistry	Determination of Ethanol in Water by HSGC-FID
Acoustics	Calibration of Load-Voltage Converter Conditioner
Acoustics	Calibration of Voltage Type Conditioner
High Voltage	Calibration of Impulse High Voltage Supply
High Voltage	Calibration of Oil Penetration Testers
High Voltage	Calibration of Standard Capacitor (High Voltage Capacitor)
High Voltage	Calibration of AC High Voltage Measurement System
High Voltage	High Voltage Tests Under Accreditation
High Voltage	Calibration of Capacitance and Loss Factor (C / tan d) Measurement System
High Voltage	Calibration of High Voltage Area Measurement System
High Voltage	Calibration of Switching Impulse High Voltage Measurement System
High Voltage	Calibration of Lightning Impulse High Voltage Measurement System
High Voltage	Calibration of Very Low Frequency AC High Voltage Measurement System
High Voltage	Calibration of High Frequency AC High Voltage Measurement System
High Voltage	Calibration of Impulse High Current Probe

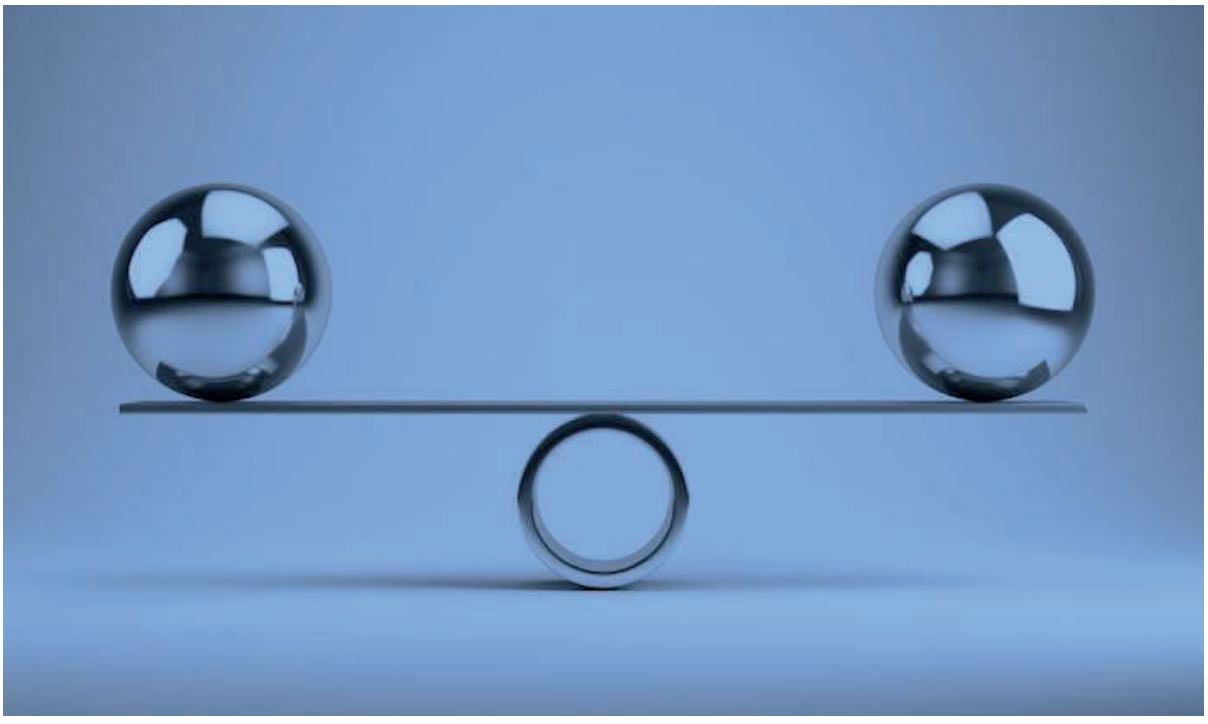
REFERENCE DEVICES / MATERIALS PRODUCED

LABORATORY	REFERENCE DEVICE/MATERIAL
Vacuum	Gravimetric Method Suitable Gas Mixing System (1 unit)
Gas Metrology	Oxygen Gas Mixture in Nitrogen (0,21 mol/mol) (1 unit)
Power and Energy	Harmonic Current Generator (1 unit)
Impedance	1 MOhm 4 TP AC Resistance (1 unit)
Impedance	2 MOhm 4 TP AC Resistance (1 unit)
Impedance	500 kOhm 4 TP AC Resistance (1 unit)
Medical Metrology	Multiple Ultrasonic Probes (1 unit)
Medical Metrology	Imaging Phantom Prototype (1 unit)
Medical Metrology	Portable Ultrasonic Power Meter (1 unit)
Reference Materials	Multi Parameter in Diesel Certified Reference Material (3 Parameters) (528 units)
Gas Metrology	Carbondioxide Gas Mixtures In Air (%10, %0.5, 850 ppm, 600 ppm, 400 ppm, 350 ppm) (6 units)
Power and Energy	AC Power Meeasruement Standard (1 unit)
Reference Materials	Sunflower Oil Reference Material (Acid Content) (2 units)
Reference Materials	Black Tea Reference Material (15 units)
Reference Materials	Multi Parameter in Diesel Certified Reference Material (5 Parameters) (528 units)
Temperature	Water Triple Point (2 units)
Reference Materials	Sunflower Oil Reference Material (Refractive Index) (3 units)
Reference Materials	Filtered Flower Honey Reference Material (4 units)
Temperature	Water Triple Point Cell (1 unit)
Power and Energy	Transformer Loss Measurement System (1 unit)
Reference Materials	Elements in Hazelnut Reference Material (600 units)
Temperature	Reference Radiation Thermometer (1 unit)
Temperature	S Type Thermocouple (9 units)
Fluid Flow	Sonic Nozzle System (1 unit)
Reference Materials	Gasoline - National Marker Compatibility Test Material (500 Units)
Reference Materials	PFOS and PFOA in Underground Water Reference Material (1180 units
Reference Materials	Soil Reference Materials (1179 units)
Reference Materials	Elements in River Water Reference Material (1250 units)
Reference Materials	Animal Feed (10 Units)
Temperature	K Type Thermocouple (1 unit)
High Voltage	Industrial PD Calibrator (1 unit)
High Voltage	Reference Calculable Lightning and Switching Impulse Voltage Calibrator (1 unit)
High Voltage	Unit Step Impulse Generator (1 unit)
High Voltage	Reference PD Calibrator (1 unit)
High Voltage	Reference PD Detector (1 unit)

In 2016, 8 national comparisons and 55 proficiency tests were organized. While the national comparisons consisted of measurements conducted in the areas of Gas Metrology, RF and Microwave, Optics, High Voltage and Electromagnetic Compatibility, the Proficiency Tests were organized by the Reference Materials, Inorganic Chemistry and Gas Metrology laboratories.



National Comparisons and Proficiency Tests Organized in the Last Five Years



NATIONAL COMPARISONS

LABORATORY	COMPARISON NAME
High Voltage	AC High Voltage Comparison
RF and Microwave	SAR Measurement Comparison
Optic	Colorimeter
Optic	Reflective Plates (d8 Geometry)
Gas Metrology	Calibration of Gas Analyzer
Electromagnetic	Transmission Broadcast
RF and Microwave	VESTEL - TÜBİTAK UME Binary Conduction Coefficient Comparison

PROFICIENCY TESTS

LABORATORY	PROFICIENCY TEST NAME
Reference Materials	Element in Waste Water
Reference Materials	Determination of Conductivity in Waste Water
Reference Materials	Determination of COD in Waste Water
Reference Materials	Determination of pH in Waste Water
Reference Materials	Determination of Delta ^{13}C İsotope Ratio in Honey
Reference Materials	Acids in Sunflower Oil
Reference Materials	Determination of Refractive Index, Number of Peroxides and Number of Iodine in Sunflower Oil
Gas Metrology	Determination of Carbon Monoxide in Nitrogen
Gas Metrology	Determination of Nitrogen Oxide in Nitrogen
Gas Metrology	Determination of Sulfur Dioxide in Nitrogen
Reference Materials	Determination of HMF, Glucose, Fructose, Saccharose, Diastase Number, Free Acidity, Moisture and Water Insoluble Solid Matter in Honey
Reference Materials	Determination of Moisture, Ash, Fat, Protein and Sedimentation Index in Wheat Flour
Reference Materials	Tea
Reference Materials	Bread
Reference Materials	Elements in Hazelnut
Reference Materials	Determination of Moisture, Crude Protein, Fat, Crude Cellulose, Crude Ash, NDF, ADF and Calcium in Animal Feed
Reference Materials	IFCC HbA1c Proficiency Test, Lyophilized Hemolysate
Reference Materials	IFCC HbA1c Proficiency Test, Whole Blood Sample
Reference Materials	Determination of Anion in Drinking Water
Reference Materials	Determination of Elements in Drinking Water
Reference Materials	Determination ofBenzoate and Sorbate in Ketchup
Reference Materials	Aflatoxin in Dried Fig

PROFICIENCY TEST

LABORATORY	PROFICIENCY TEST NAME
Reference Materials	Sulfur Dioxide in Dried Apricots
Reference Materials	Coal
Reference Materials	pH in Fruit Juice
Reference Materials	Petroleum Proficiency Tests
Reference Materials	Element in Tomato Paste
Reference Materials	Determination of Solid Suspension in Water
Reference Materials	Determination of Conductivity in Water
Reference Materials	PAH in Water
Reference Materials	Determination of pH in Water
Reference Materials	Color Blur Alkalinity TOC in Water
Reference Materials	Determination of Element in Soil
Reference Materials	Determination of Conductivity in Soil
Reference Materials	Determination of pH in Soil
Reference Materials	Determination of Total Organic Matter in Soil

INTERNATIONAL ACTIVITIES

TÜBİTAK UME raised its profile with new initiatives to increase its engagement with the BIPM, regional metrology organizations and other national metrology institutes in the world.

New memorandums of understanding were signed with the NMIs of Iran and Burkina Faso, while those that had been previously signed with the NMI of Moldova and the GCC Gulf Standardization Organization (GSO) were renewed. New cooperation initiatives were started with partners in Iraq, Sudan, Tunisia, Ethiopia, Germany and Russia.

As part of the activities of the Metrology Committee of the Standards and Metrology Institute for Islamic Countries (SMIIC), TÜBİTAK UME organized training courses in the fields of Pressure, Electricity and Dimensional Metrology. The courses were attended by a total of 32 participants from Benin, Bosnia-Herzegovina, Burkina Faso, Guinea, Iran, Cameroon, Niger, Senegal and Sierra Leone.

TÜBİTAK UME signed a new Road Map for Cooperation with GULFMET, of which it is an associate member, outlining the specific activities to be undertaken in support of its development as a regional metrology organization.

The CIPM approved the full membership of TÜBİTAK UME in the Consultative Committee on Time and Frequency (CCTF).

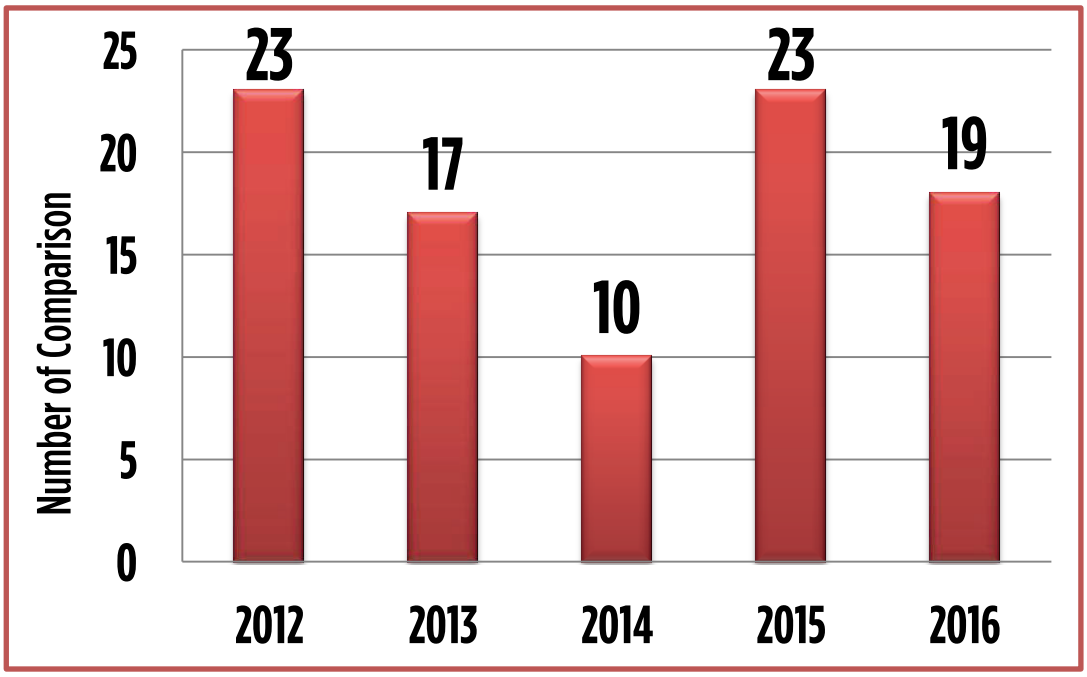
With these steps, TÜBİTAK UME moved closer to its goal of becoming one of the leading national metrology institutes in Europe and the world by 2023, the centennial of the establishment of the Republic of Turkey.

TÜBİTAK UME participated in 19 international measurement comparisons in 2016.

INTERNATIONAL COMPARISONS

LABORATORY	COMPARISON NAME
Bioanalysis	Determination of Catalytic Concentration of Alpha-Amylase in Serum (CCQM)
Bioanalysis	Relative Quantification of Bt63 in GM Rice Matrix Example (CCQM)
Organic Chemistry	Aflatoxin in Dried Fig (CCQM)
Organic Chemistry	Characterization of Organic Material for Chemical Purity (Folic Acid) (CCQM)
Organic Chemistry	Determination of Ethanol in Aqueous Matrix (CCQM)
Organic Chemistry	Determination of Urea and Uric Acid in Human Serum (CCQM)
Organic Chemistry	Polycyclic Aromatic Hydrocarbon Acetonitrile (CCQM)
Organic Chemistry	Polycyclic Aromatic Hydrocarbon in Tea (CCQM)
Organic Chemistry	Constant Isotope Ratio Delta Values in Honey (CCQM)
Vacuum	Comparisons of Absolute Pressure Between 0.03 Pa and 13 Pa (COOMET)
Vacuum	Comparisons of Absolute Pressure Between 0.3 mPa and 0.9 Pa (COOMET)
Gas Metrology	Carbon Dioxide in Air (CCQM)
Mass	Comparison in Mass Standards (GULFMET)
Temperature	Comparison of SPRT Calibration from Hg TP to Zn FP (As A Pilot) (GULFMET)
Temperature	Comparison of Radiation Temperature Scale (with INRIM)
Temperature	Comparison of SPRT Calibration from Hg TP to Zn FP (with SASO)
Temperature - Chemistry	Comparison of SPRT Calibration from Al FP to Ag FP (with SASO)
Temperature	Comparison of SPRT Calibration from Ar TP to Zn FP (EURAMET)
Electrochemistry	pH Measurement in COOMET 655 / RU / 15 Phosphate Buffer (pH ~7.0) (COOMET)

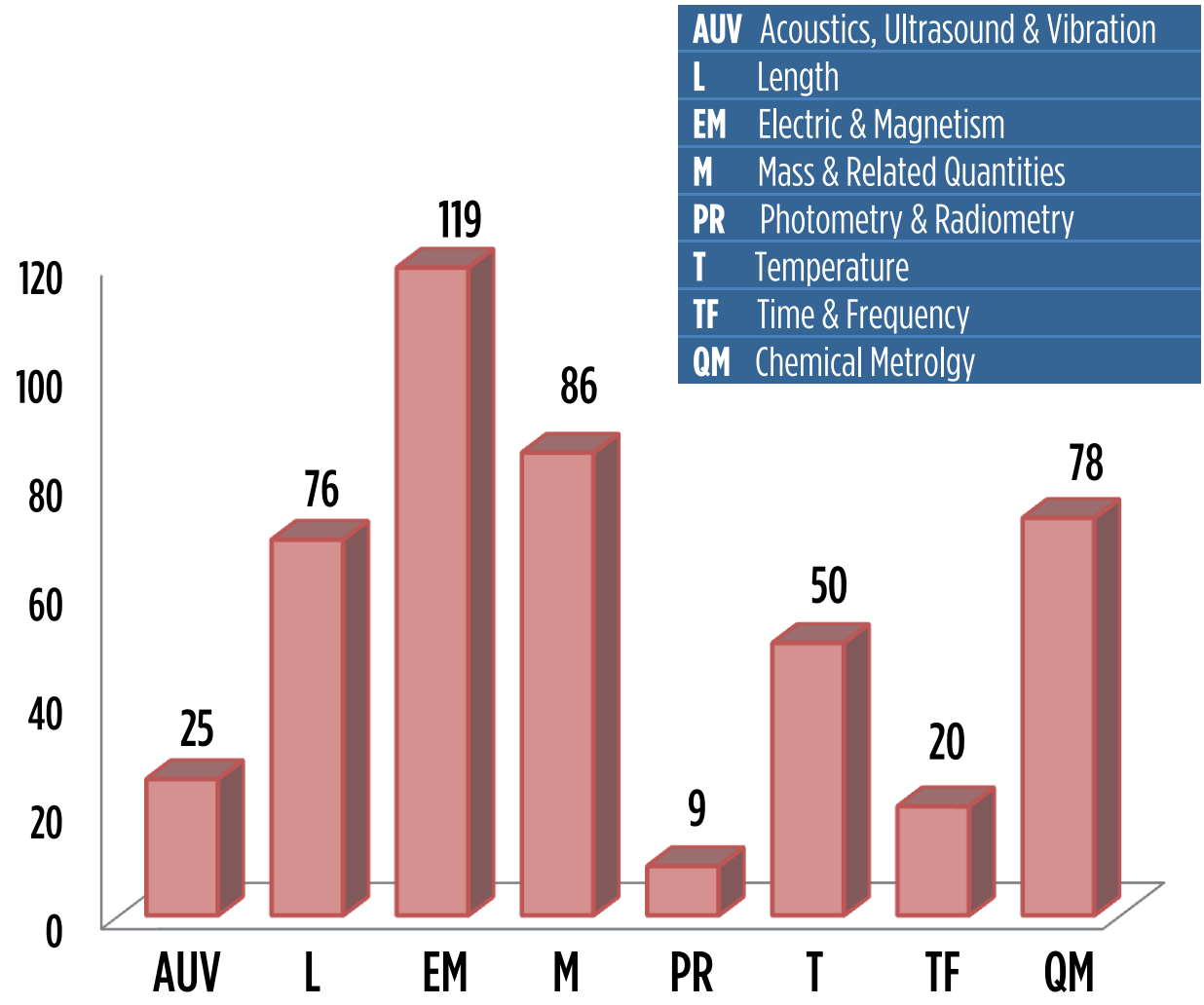
INTERNATIONAL COMPARISONS



Number of International Comparisons Joined in the Last 5 Years.

TÜBİTAK UME has 463 Calibration and Measurement Capabilities (CMCs) published in the Key Comparison Database (KCDB) maintained by the BIPM. The certificates issued for calibrations encompassed by these CMCs are accepted by all other institutions that have signed the CIPM Mutual Recognition Arrangement (CIPM MRA). In 2016, TÜBİTAK UME's number of CMCs in the Chemistry area reached 78.

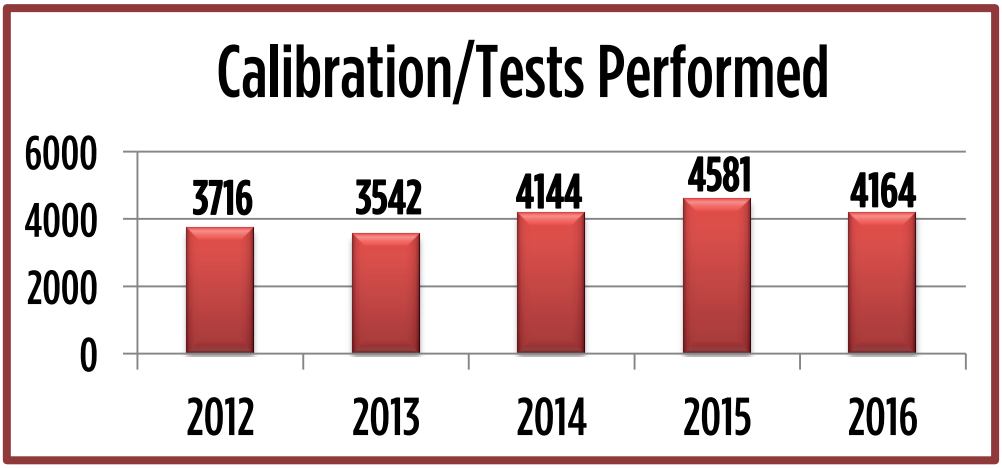
CMCs PUBLISHED IN THE BIPM KEY COMPARISON DATABASE (KCDB)



OUR SERVICES

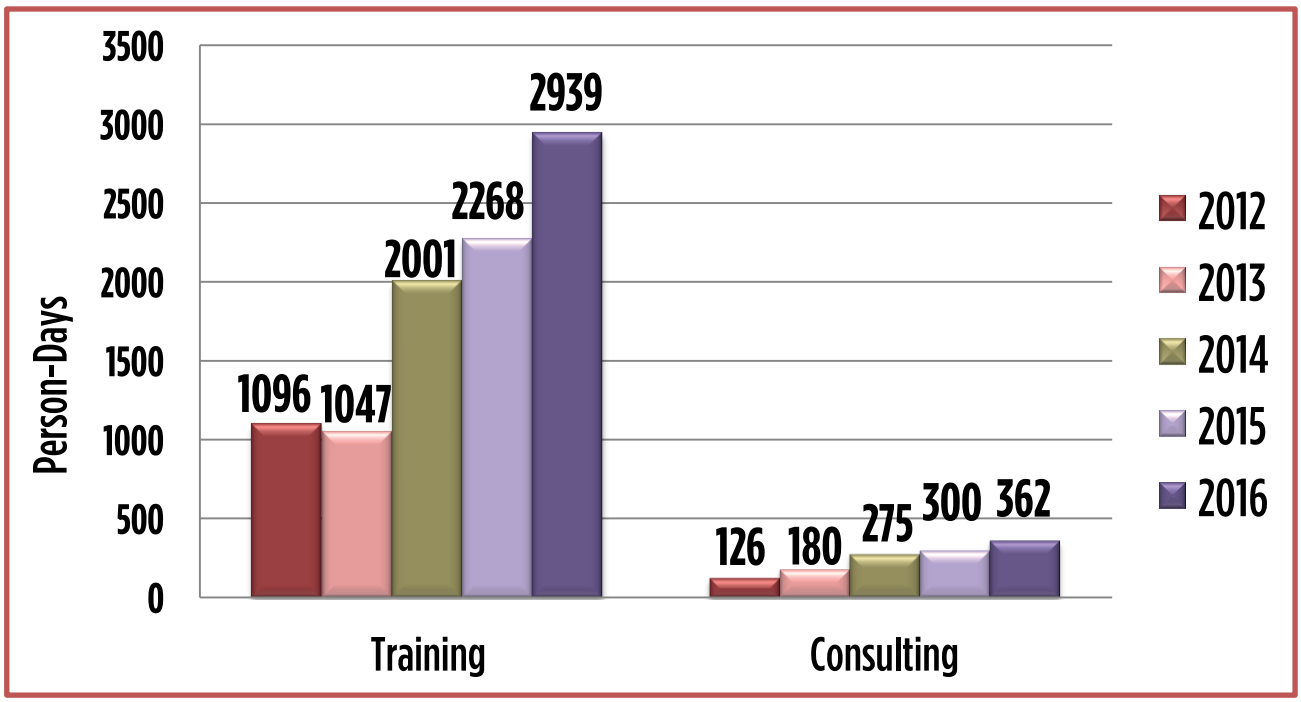
CALIBRATION AND TEST SERVICES

TÜBİTAK UME offered 611 types of calibrations/tests to customers in year 2016. Of these services, 292 were accredited.



TRAINING AND CONSULTING SERVICES

In 2016, 2939 person-days of training services of were provided to domestic and international customers, A total of 362 person-days of consulting services were provided, of which 182 person-days were expended on support for accreditation assessments and 180 person-days on provision of on-site technical support and problem resolutions.



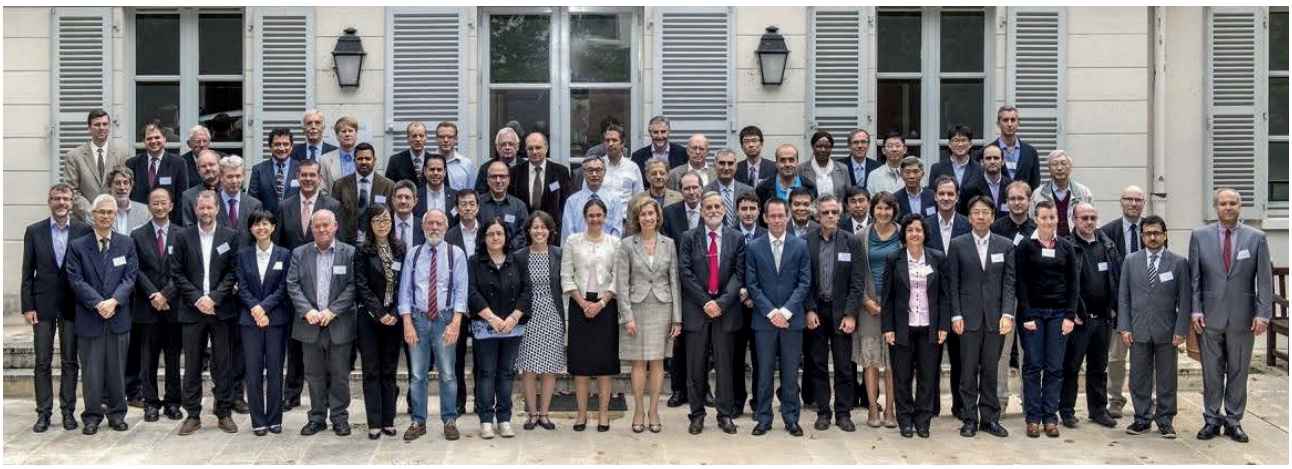
HIGHLIGHTS OF 2016

A Memorandum of Understanding was signed with the National Metrology Center of Iran – Institute of Standards and Industrial Research of Iran (NMCI–ISIRI) on April 16, 2016, in Ankara. A subsequent action plan for cooperation was signed on October 5, 2016 in Tehran.

The Memorandum of Understanding signed with the GCC Gulf Standardization Organization (GSO) in 2011 was renewed for a period of five years on December 16, 2016.

The CIPM approved the full membership of TÜBİTAK UME in the CIPM Consultative Committee on Time and Frequency (CCTF).

With this, TÜBİTAK UME is now a full member of 7 CIPM Consultative Committees out of the 8 in which it could potentially be a full member. TÜBİTAK UME is also a full member of the Consultative Committees for Acoustics and Vibration (CCAUV), Electricity and Magnetism (CCEM), Length (CCL), Photometry and Radiometry (CCPR), Amount of Substance: Metrology in Chemistry and Biology (CCQM) and Thermometry (CCT)



A Memorandum of Understanding was signed with the Burkinabe Agency of Standardization, Metrology and Quality (ABNORM), the national metrology institute of Burkina Faso on October 8, 2016.

In addition to the Time and Frequency Laboratory established for the Saudi Standards, Quality and Metrology Organization (SASO) for dissemination of the national time scale of Saudi Arabia; TÜBİTAK UME also developed the Makkah Time Center (MTC) which has great significance for the Islamic world.

A training program was initiated for the technical staff of member institutions of the Metrology Committee of the Standards and Metrology Institute for Islamic Countries (SMIIC) as a part of the Metrology Committee's action plan for 2016. After the first session held in Tunisia, TÜBİTAK UME organized and hosted the second session of the training program on February 22-26, 2016

TÜBİTAK UME also hosted the Third Annual Meeting of the SMIIC Metrology Committee on January 18, 2016.

Two researchers from TÜBİTAK UME took part as instructors in the "Leader of Tomorrow" course held at the BIPM in France between November 7 and 9, 2016. The course was sponsored by NIST and organized as part of the BIPM Capacity Building and Knowledge Transfer (CBKT) Programme.

TÜBİTAK UME signed a cooperation agreement with PTB of Germany to conduct joint work on a comparison of reference calorimeters, production of reference materials for calorimeters and measurements of viscosity and density.

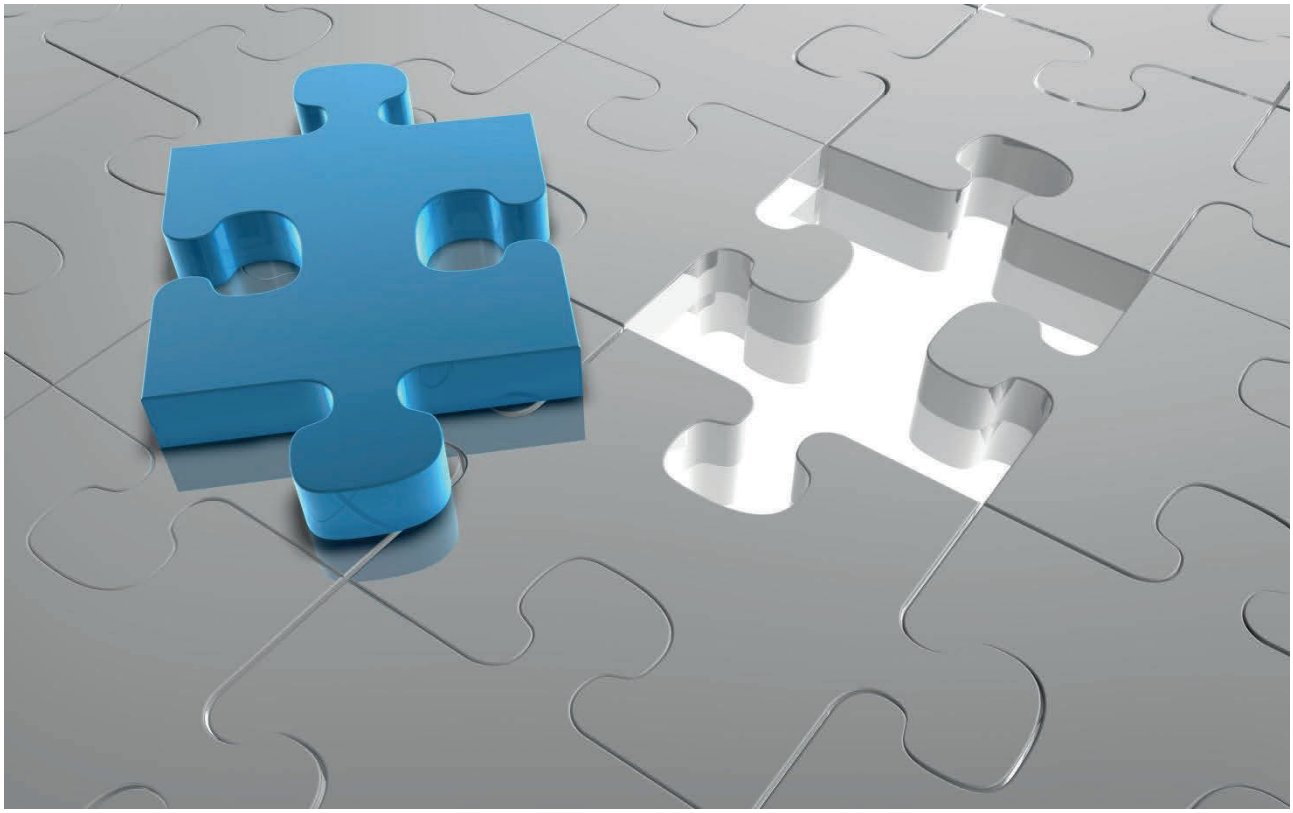
Cooperation was also initiated between the TÜBİTAK UME Vacuum Laboratory and the D.I. Mendeleyev Institute for Metrology (VNIIM) of Russia in the field of vacuum standards.

TÜBİTAK UME's efforts to secure financing from the Ministry of Development for the purpose of developing existing laboratories and building new facilities were continued in 2016.

Significant planning studies were undertaken to ensure that TÜBİTAK UME will remain up-to-date with fast developing production technologies, increase its ability to participate in and give direction to cutting edge research activity and critical processes that will determine the future of metrology, such as the redefinition of the SI, and avoid dependence on foreign suppliers for important technologies.

Investment plans consisting of 98 different actions to be taken over the near and medium term were divided into two phases with the first phase aiming for the completion of 22 actions towards renewing and developing TÜBİTAK UME's infrastructure.

Citing the important need to prevent foreign dependence and keep abreast of developments in the world of metrology, TÜBİTAK UME submitted a proposal to the Ministry of Development with a value of 150 million Turkish Liras that entails the construction of a new 4200 m^2 building, the hiring of an additional 33 researchers and 12 technicians and significant upgrades to existing laboratories.



QUALITY MANAGEMENT SYSTEM & ACCREDITATION

For the 11th Annual Meeting of the EURAMET Technical Committee for Quality (TC-Q) held on April 12-14, 2016:

- The annual report summarizing the operation of the TÜBİTAK UME Quality Management System in 2016 was submitted to the TC-Q Secretary.
- Support was given for the preparation of 2015 annual QMS report of the Atomic Energy Agency of Turkey (TAEK).
- The Annual Meeting was attended by TÜBİTAK UME representatives.

At the meeting, TÜBİTAK UME's annual QMS report was approved without reservations and TAEK's annual report was accepted on the condition that one minor clarification is submitted.

Accreditation surveillance assessments for the TÜRKAK Accreditation Certificates AB-0034-K (Calibration) and AB-0092-T (Testing) were carried out by a 3 TÜRKAK assessors November 15-17, 2017. The assessment covered the following areas of activity:

- Acoustic Laboratory (AB-0092-T)
- RF & Microwave Laboratory (AB-0034-K)
- Quality Management System (AB-0034-K, AB-0092-T)

TÜRK AKREDİTASYON KURUMU

AKREDİTASYON SERTİFİKASI

Deney Laboratuvarı olarak faaliyet gösteren,

TÜBİTAK ULUSAL METROLOJİ ENSTİTÜSÜ DENEY LABORATUVARI

TÜBİTAK Gebze yerleşkesi Barış Mh. Dr.Zeki Acar Cd. No:1 Gebze 41470 KOCAELİ / TÜRKİYE

TÜRKAK tarafından yapılan denetim sonucunda TS EN ISO/IEC 17025:2012 Standardına göre Ek'te yer alan kapsamlarda akredite edilmiştir.

Akreditasyon No : **AB-0092-T**
Akreditasyon Tarihi : **16 Ekim 2006**
Revizyon Tarihi / No : **1 Kasım 2016 / 07**

Bu Sertifika, yukarıda açık adı ve adresi yazılı Kuruluşun TS EN ISO/IEC 17025:2012 Standardına, ilgili Yönetmelik ve Tebliğlere uygunluğunu sürdürmesi halinde , **8 Aralık 2018** tarihine kadar geçerlidir.

Dr. H. İbrahim ÇETİN
Genel Sekreter

Türk Akreditasyon Kurumu (TÜRKAK) ISO/IEC 17025 alanında Avrupa Akreditasyon Birliği (EA) ve Uluslararası Laboratuvar Akreditasyon Birliği (ILAC) ile çok taraflı anlaşma (MLA/MRA) imzalamıştır.

TÜRK AKREDİTASYON KURUMU

AKREDİTASYON SERTİFİKASI

Kalibrasyon Laboratuvarı olarak faaliyet gösteren,

TÜBİTAK ULUSAL METROLOJİ ENSTİTÜSÜ
Kalibrasyon Laboratuvarı
TÜBİTAK Gebze Yerleşkesi Barış Mh. Dr. Zeki Acar Cd. No:1
41470 KOCAELİ / TÜRKİYE

TÜRKAK tarafından yapılan denetim sonucunda TS EN ISO/IEC 17025:2012 Standardına göre Ek'te yer alan kapsamlarda akredite edilmiştir.

Akreditasyon No : **AB-0034-K**
Akreditasyon Tarihi : **29 Ağustos 2006**
Revizyon Tarihi / No : **9 Aralık 2014 / 09**

Bu Sertifika, yukarıda açık adı ve adresi yazılı Kuruluşun TS EN ISO/IEC 17025:2012 Standardına, ilgili Yönetmelik ve Tebliğlere uygunluğunu sürdürmesi halinde , **8 Aralık 2018** tarihine kadar geçerlidir.

Dr. H. İbrahim ÇETİN
Genel Sekreter Vekili

TÜBİTAK UME's Quality Manager provided training on "RMO Structure and QMS: EURAMET" as an invited lecturer at the "Leaders of Tomorrow" training course that was organized as part of the BIPM Capacity Building and Knowledge Transfer Program on October 7-10, 2016.

Training was provided to the SASO NMCC Quality Manager and 2 administrative personnel between August 22 and September 2, 2016 on the management requirements of the ISO/IEC 17025 standard and QMS practices.

Upon the request of the Training Center for Industrial Technologies under the Ministry of Defence, the following courses were provided:

- Requirements of the TS EN ISO/IEC 17025 Standard to 37 persons on May 4, 2016,
- Measurement Uncertainty Calculations to 45 persons on May 5, 2016,
- Internal Assessments to 45 persons on May 6, 2016

TÜBİTAK UME's suggestions concerning the "TS EN ISO/IEC 17025 Checklist for Food Chemistry Laboratories" drafted by the TÜRKAK Sector Committee for Food were submitted to TÜRKAK.

An agreement was reached to draft a guidance document on "Calculation of Measurement Uncertainty" and the road map to be followed for preparing the document was submitted to TÜRKAK.

Work continued on bringing the Quality Documentation Management System (QDMS) online so that QMS practices are moved into the electronic sphere.

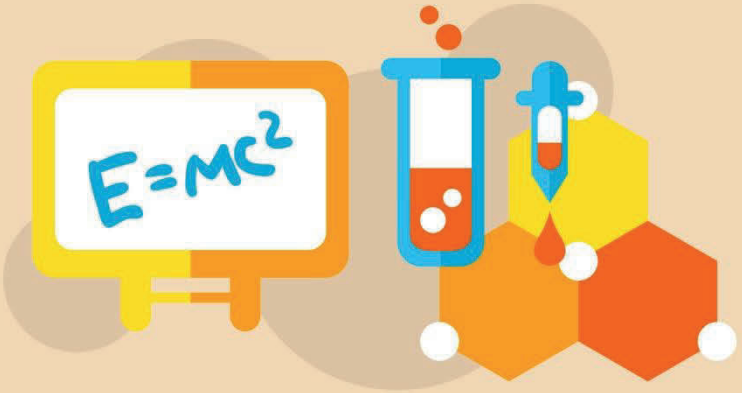
TÜBİTAK UME staff participated in the "TÜRKAK Assessor Experience Sharing Meeting and Refresher Training" held in Istanbul on October 7-9, 2016 and gave presentations on the following subjects:

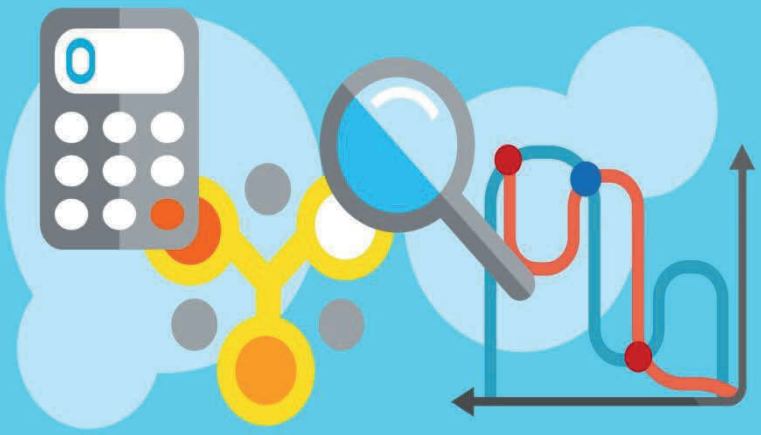
- Measurement Uncertainty
- Determination of Calibration Periods
- Interpretation of Calibration Certificates
- Important Points in Evaluation of Certified Reference Materials

KNOWLEDGE & TECHNOLOGY TRANSFER

The postgraduate degree program in Metrology offered at the Gebze Technical University had 12 registered students at the end of 2016.

The program aims to raise highly qualified researchers in metrology and covers measurement techniques used in areas of increasing priority for Turkey, such as quantum metrology, nanotechnologies, biomedical engineering, renewable energy Technologies.



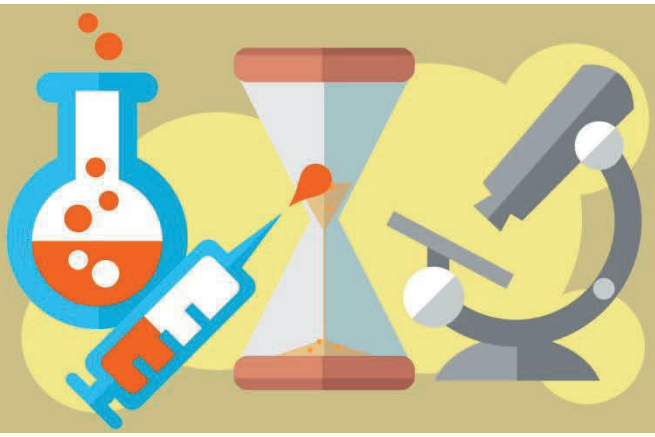


A total of 14 courses are currently offered in the program. New courses addressing additional areas of expertise will be added in the years ahead.

Researchers from TÜBİTAK UME determine the course curricula, prepare the lectures and provide classroom instruction.

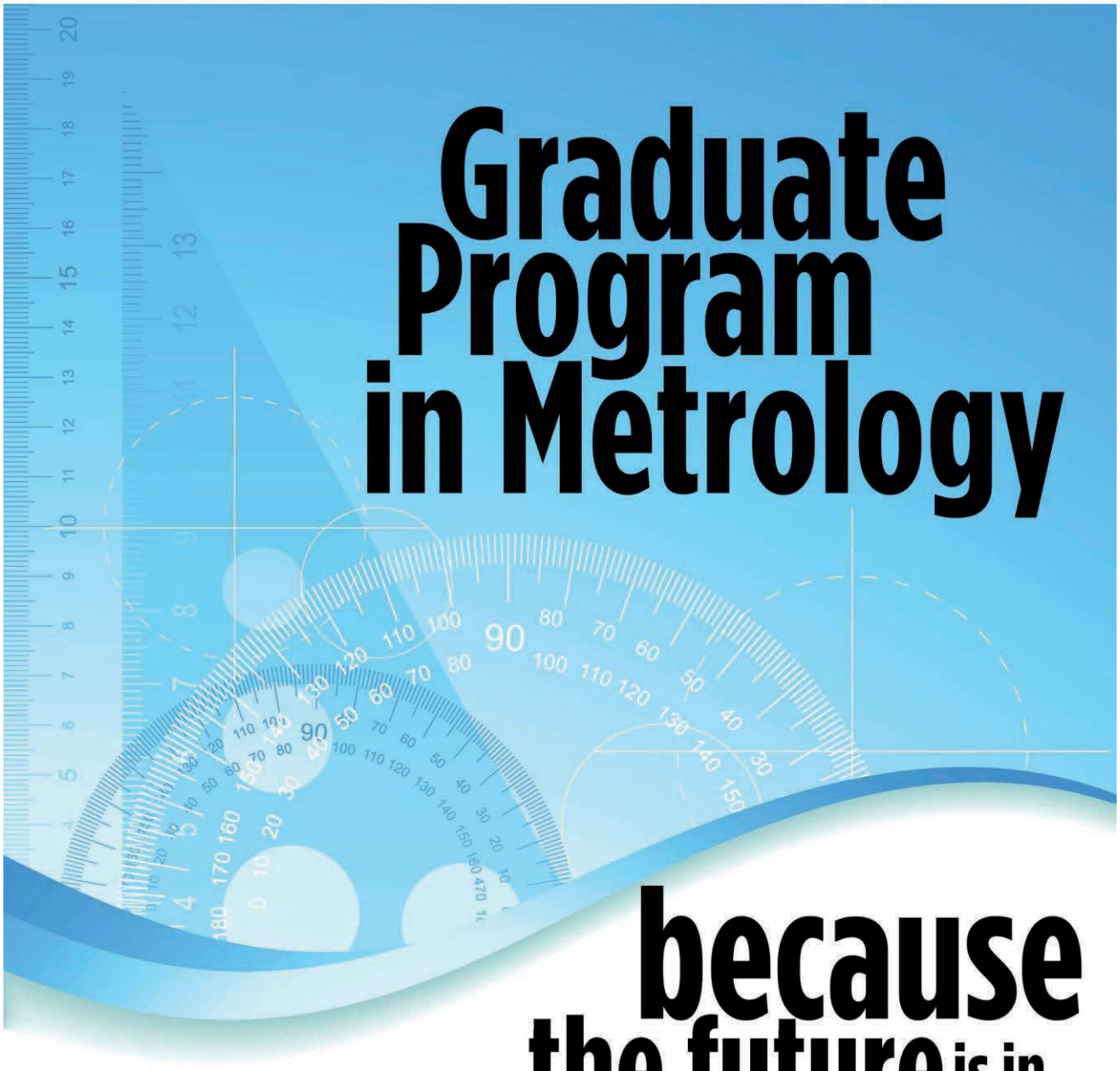
TÜBİTAK UME researchers act as thesis co-advisors to students, who also have the opportunity to use TÜBİTAK UME laboratories to perform their research.

The language of instruction is English, which allows the participation of international students in the program.

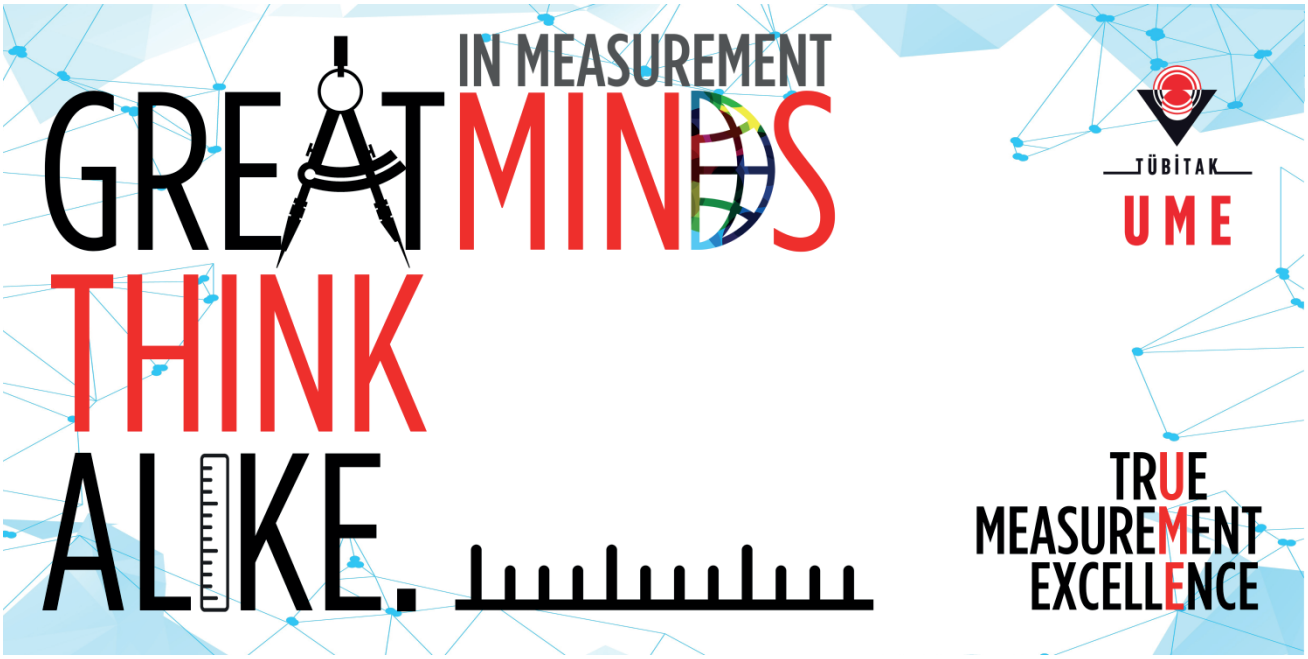


GEBZE TEKNİK ÜNİVERSİTESİ

TÜBİTAK UME



TÜBİTAK UME organized numerous business development meetings to develop new project ideas in partnership with leading industrial establishments and public agencies and participated in 2 national and 4 international conferences, various workshops, as well as fairs and exhibitions with the aim of promoting its capabilities and infrastructure.



TÜBİTAK UME participated in the expoMED Eurasia Fair held at the Beylikdüzü - TÜYAP Fair and Exhibition Center on March 24-27, 2016, the ICSG 2016 Smart Grids and Cities Congress and Fair on April 20-21, 2016, the National Laboratory Accreditation and Safety Symposium and Exhibition hosted by the Yıldız Technical University on May 11-13, 2016 and the MÜSİAD High Tech Port Fair held at the Istanbul Fair Center on November 9-12, 2016.

2016 IN NUMBERS

R & D Projects **56**

National & International Measurement Comparisons **27**

Reference Materials & Standards Produced **35**

Measurement Quantities Measured **111**

Primary Level Standards **120**

Types of Calibrations/Tests Offered **611**

Calibrations / Tests Performed **4164**

International & National Publications **100**

Memberships in Intl. & Natl. Technical Committees **120**

Employees **254**

STEPS TO SUCCESS

Medical Metrology Laboratory Established at TÜBİTAK UME

The Medical Metrology Laboratory entered into service as the culmination of the long-running Medical Metrology Feasibility Project.

The main goal of the Medical Metrology is to ensure the reliability of medical measurements through dissemination of measurement traceability to medical laboratories within Turkey and abroad via the provision of calibration, measurement and test services.

The laboratory aims to conduct research on subjects that are important in terms of meeting national and stakeholder demands and is already taking part as a partner in a number of projects funded within the European Metrology Research Programme and its successor, the European Metrology Programme for Innovation and Research.

In addition to work performed to establish the traceability of medical devices and ensure their accuracy, the Medical Metrology Laboratory will produce certified reference materials for autoanalyzers and design and produce calibrators for medical devices.

Additionally, the laboratory plans to develop systems and projects for applications of ultrasonic techniques in medicine and conduct work on performance tests of hearing aids. Training will be provided to professionals who calibrate medical devices.

The Medical Metrology Laboratory of TÜBİTAK UME will facilitate monitoring of the quality of medical services in Turkey, reducing dependence on foreign suppliers in this important field.

Two New Laboratories for TSE from TÜBİTAK UME

Force Calibration and Hardness Block Calibration Laboratories, established through cooperation between the Turkish Standards Institute (TSE) and TÜBİTAK UME within the framework of the Program to Support the Research and Development Projects of Public Agencies, were formally inaugurated with the a ceremony held on January 11, 2016.

Producers in automotive, aeronautics, shipbuilding, machinery, metals and chemicals industries produce and utilize many mechanical parts, construction iron and steel, plate metals, plastic pipes, cables, security belts and similar materials. The new laboratories will perform calibrations of force measurement devices and hardness blocks in order to provide the necessary measurement references to determine the accuracy of universal test machines and hardness testers used in the performance and safety tests of these materials. The laboratories are equipped with four force calibration machines and two hardness calibration machines that were custom designed and produced entirely using local capabilities.

This transfer of technology accomplished through the sharing of TÜBİTAK UME's expertise and experience will allow TSE to meet the demands of industry for calibration of force measurement devices and hardness blocks, thus ensuring the traceability of a greater share of industrial force and hardness measurements.

TÜBİTAK UME on the Exporters' Honors List

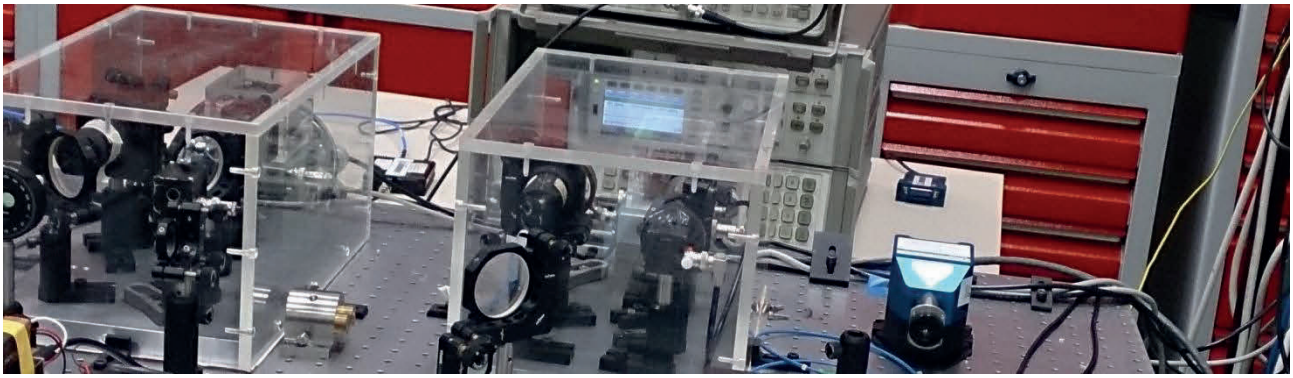
TÜBİTAK UME was named on the Electrical – Electronics Exporters Honors List announced annually by the Turkish Electro Technology Exporters' Association (TET) based on the results of their evaluation of the export performance of Turkish companies active in the industry.

TÜBİTAK UME was 81st on the list, which names all establishments that have exported a minimum of 10 million USD worth of electrical and electronics goods within the given year. TÜBİTAK UME was able to achieve an export volume of 13 million USD in the year 2015, mostly within the context of its activities to support the development of scientific metrology infrastructures in the Middle East, Eastern Europe, the Caucasus and Africa.

The list seeks to draw attention to and honor those companies that contribute to the competitive performance of Turkey's economically significant electrical and electronic technologies industry.

The Turkish Electro Technology Exporters' Association (TET), with nearly 6,500 members, is the largest among 61 exporters' unions that operate under the umbrella of the Turkish Exporters Assembly. Its activities focus on boosting the export performance of the industry through promoting product diversification and increasing the competitive strength of its members.

Picometre and Nanoradian Scale Measurements Achieved at TÜBİTAK UME



TUBITAK UME has measured interatomic distances with picometer (one trillionth of a meter) and angles in 1 nanoradian steps produced by a small angle generator with picoradian sensitivity using the Differential Fabry-Perot Interferometer (DFPI) developed and improved under the scope of joint research project within the EC-funded European Metrology Research Program (EMRP)

The improved method based on the frequency measurements with DFPI benefits from its frequency based measurement advantages and the stable measurements of the highly precise angle generator and was used for the first time for nanoradian angle measurements.

Between the years 2008-2011, within the scope of the EMRP NANOTRACE Project, displacement measurements with picometre sensitivity, which have important potential applications in the nanotechnology area, were carried out using the new methodology based on beat frequency measurements. The first applications were introduced using the Differential Fabry – Perot interferometer developed for these measurements.

As a continuation of this study, under the EMRP project SIB08 "Subnano - Traceability of sub-nm Length Measurements" Project, work was carried out for a comparison measurement in which the improved Differential Fabry Perot Interferometer of TUBITAK UME was compared with the X-ray interferometer developed by the National Physical Laboratory (NPL) making use of the lattice spacing of the Si atoms forming the interferometer. The group of the researchers achieved picometre level accuracy of the displacements corresponding to the distances between layers of the Si atoms.

Further to this, 1 nanoradian angular steps obtained with the precise angle generator improved by TUBITAK UME in the scope of the SIB58 Angles Project were detected as a frequency change of the differential Fabry-Perot Interferometer which was improved during the SIB08 subnano Project. The frequency -based angle measurement method that was improved with joint efforts of the TUBITAK UME SIB08 subnano and SIB58 Angles projects teams seems to be important as it constitutes an alternative method for nanoradian and sub-nanoradian angle measurements. To define what these measured values means; 1 nanoradian angular value indicates that a missile with a range of 1,500 kilometers could reach the target with an error of 1.5 mm, while the picoradian level measurement; symbolizes that this error of 1.5 mm to the target can be detected with a resolution of one thousandths of its value.

The information obtained and produced, such as the angular adjustment of mirrors and optics in nanoradian level used in the space work of institutions like NASA, production of the mirrors utilized for directing X-rays in accelerator centers like CERN, investigation of the material structure using gamma rays is expected to meet the demands of the nano and picoradian level angular measurements using evolving technology needs. Besides it is also expected that it will meet the top-level demands of nanoradian angle metrology reference standards for the development of new generation measurement instruments and for the improvement of existing ones.

TÜBİTAK UME Granted ISO Guide 34 Accreditation

TÜBİTAK UME is proud to be the first institution in Turkey, and one of the few in the world, to have succeeded in obtaining accreditation as a producer of reference materials according to the ISO Guide 34.

ISO Guide 34 is a guidance document that comprehensively defines requirements for all stages in the production of CRMs, including production planning, selection of raw materials, characterization, assessment of homogeneity and stability, assignment of certificate values and uncertainties, establishing traceability to the SI whenever possible, as well as the their storage and distribution, and finally, for the appropriate documentation of all of these stages.

As a conclusion of the accreditation assessment carried by a team of 5 assessors from Turkey and abroad with expertise in the subject, 18 CRMs, certified in the period from 2013 to up to the time of the assessment and offered to test laboratories active in the areas of food safety, environment, clinical medicine and fuels, were included in the accreditation scope.

PUBLICATIONS AND PATENTS

SCI Articles

57 articles authored or co-authored by TÜBİTAK UME researchers were published in SCI journals in 2016.

1. Sozeri, H., Mehmedi, Z., Erdemi, H., Baykal, A., Topal, U., Aktas, B. "Microwave Properties of $BaFe_{11}Mg^{2+}_{0.25}X^{2+}_{0.25}Ti^{4+}_{0.25}O_{19}$ (X^{2+}=Cu, Mn, Zn, Ni and Co) Nanoparticles in 0–26.5 GHz Range", Ceramics International, 42:2 Part A (2016) : 2611-
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3. Sozeri, H., Genc, F., Unal, B., Baykal, A., Aktas, B. "Magnetic, Electrical and Microwave Properties of Mn-Co Substituted $Ni_xZn_{0,8-x}Fe_2O_4$ Nanoparticles", Journal of Alloys and Compounds , 660 (2016) : 324-335
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10. Tabacaru, C., Campo, D.D., Gomez, E., Izguiedo, C.G., Welna, A., Kalemci, M., Pehlivan, O. "The Influence of Some Relevant Metallic Impurities in the Triple Point of Mercury Temperature", Metrologia, 53:1 (2016) : 51-60

11. Swart, C., Gantois, F., Petrov, P., Entwisle, J., Goenaga-Infante, H., Nousiainen, M., Bilsel, M., Binici, B., Gonzalez-Gago, A.G., Profrock, D., Goren, A.C. "Potential Reference Measurement Procedures for PBDE in Surface Water at Levels Required by the EU Water Frame Directive", Talanta, 152:5 (2016) : 251-258

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International Conference Papers

71 international conference papers were authored or co-authored by TÜBİTAK UME researchers in 2016.

1. Andreas, B., Friedrich, K., Kuetgens, U., Quabis, S., Weichert, C., Yacoot, A., Dongmo, H., Voigt, D., Van De Nes, A.S., Van Den Berg, S.A., Celik, M., Hamid, R., Demir, A., Nihtianov, S., Nojdelo, R. "Sub-nanometre Length Metrology", Nanoscale 2016 , Wroclaw (09-11/03/2016) : 3 p.
2. Sariyerli, G.S., Akcadag, U.Y., Sakarya, O. "The Automatization of the Primary Level Hydrometer Calibration System of Volume, Density and Viscosity Laboratory in TUBITAK UME", CAFMET, (21-24/03/2016), Dakar (Presentation)
3. Sadikoglu, E. "QMS Annual Report for the Year 2015 by TUBITAK UME ", 11th EURAMET TC-Q Meeting, Sarajevo (12-14/04/2016) : 20 p.
4. Hatipoglu, S.D., Yalcinkaya, B., Akgoz, M., Ozturk, T., Topcu, G., Goren, A.C. "Determination of Psychoactive Substances in Ten Salvia Species from Turkey ", 2nd International Congress of Forensic Toxicology, Ankara (26-29/05/2016) : 1 p.
5. Zhao, D., Cakir, S., Sen, O. "Uncertainty Evaluation of an Alternative Conducted Emission Test Method", 7th Asia Pasific International Symposium on Electromagnetic Compatibility, Shenzhen (18-21/05/2016) : 4 p.
6. Sen, O., Cakir, S., Celep, M., Cinar, M., Hamid, R., Cetintas, M. "Influence of Dielectric Support on Military Radiated Emission Tests Above 30 MHz ", 7th Asia Pasific International Symposium on Electromagnetic Compatibility, Shenzhen (18-21/05/2016) : 3 p.
7. Cakir, S., Ozturk, M., Sen, O., Tektas, C.B., Acak, S., Cetintas, M. "MIL STD 461F CS101 Testing and Power Frequency Cancelation", 7th Asia Pasific International Symposium on Electromagnetic Compatibility, Shenzhen (18-21/05/2016) : 3 p.
8. Karaboce, B., Cetin, E., Durmus, H.O. "Investigation of temperature rise in tissue mimicking material induced by a HIFU transducer", 2016 IEEE International Symposium on Medical Measurements and Applications (MeMeA) Kongresi , Benevento (15-18/05/2016) : 6 p.

9. Karaboce, B., Kaleci, D., Sahin, A. "Experiential Investigation of Nonlinear Acoustic Field Structure in Two and Three Dimensions", 2016 IEEE International Symposium on Medical Measurements and Applications (MeMeA) Kongresi , Benevento (15-18/05/2016) : 6 p.
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11. Durgut, Y. "Fall Rate Measurement System at UME for Cross-Float Method", TCM Mass and Related Quantities Meeting, (09/05/2016), Budva
12. Durgut, Y. "Drop Mass Dynamic Pressure Measurement Standard", TCM Mass and Related Quantities Meeting, (09/05/2016), Budva
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14. Mace, T., Walden, J., Tarhan, T. "Dynamic Reference Standards for CO and N2O", HIGHGAS Stakeholder Workshop, (09/03/2016), Delft
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16. Abdo, Y., Celep, M. "New Effective Coaxial Twin-Load Microcalorimeter system", Conference on Precision Electromagmetic Measurements (CPEM 2016), Ottawa (10-15/07/2016) : 2 p.
17. Saher, K., Karaboce, B. "Auralizations of Monosyllabic Word Lists For Hearing Impaired Students - A Preliminary Study", 9th Iberian Congress and the 47th Spanish Congress on Acoustics (EuroRegio2016), Porto (13-15/06/2016) : 10 p.
18. Coskun Ozturk, T., Ahmadov, H., Birlikseven, C., Gulmez, G. "Feasibility Study of Electrical Measurements of Oscillating-Magnet Watt Balance ", Conference on Precision Electromagnetic Measurements (CPEM 2016), Ottawa (10-15/07/2016) : 2 p.
19. Ahmadov, H. "An Oscillating Magnet Watt Balance ", Conference on Precision Electromagnetic Measurements (CPEM 2016), Ottawa (10-15/07/2016) : 2 p.

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24. Houtzager, E., Mohns, E., Fricke, S., Ayhan, B., Kefeli, T., Cayci, H. "Calibration Systems for Analogue Non-Conventional Voltage and Current Transducers", Conference on Precision Electromagnetic Measurements (CPEM 2016), Ottawa (09-16/07/2016) : 2 p.

25. Kirbas, C., Andersson, H., Guglielmone, C., Wittstock, V., Bilgic, E. "Primary Sound Power Sources for the Realisation of the Unit Watt in Airborne Sound", 45th International Congress and Exposition on Noise Control Engineering (Inter-Noise 2016), Hamburg (21-24/08/2016) : 12 p.

26. Guglielmone, C., Wittstock, V., Kirbas, C., Andersson, H. "Main Achievements of the EMRP Sound Power Project and Future Prospects", 45th International Congress and Exposition on Noise Control Engineering (Inter-Noise 2016), Hamburg (21-24/08/2016) : 7 p.

27. Brezas, S., Cellard, P., Andersson, H., Guglielmone, C., Kirbas, C. "Dissemination of the Unit Watt in Airborne Sound : Aerodynamic Reference Sound Sources as Transfer Standards", 45th International Congress and Exposition on Noise Control Engineering (Inter-Noise 2016), Hamburg (21-24/08/2016) : 9 p.

28. Saher, K., Nas, S., Karaboce, B., Kirbas, C., Bilgic, E. "Room Acoustic Modelling of a Reverberation Chamber", 45th International Congress and Exposition on Noise Control Engineering (Inter-Noise 2016), Hamburg (21-24/08/2016) : 7 p.

29. Cayci, H., Gulnihar, K., Kefeli, T., Yilmaz, O. "Evaluation of a Pc-Oscilloscope Based Test Setup for Flicker & Harmonic Measurements with High Accuracy", VSL-VSL- Nederlands Metrologisch Instituut, (01-03/06/2016), Delft (Presentation)

30. Cayci, H., Gulnihar, K., Kefeli, T., Yilmaz, O. "Design of a Programmable Round-Robin Test Device for Steady-State Harmonics", VSL- Nederlands Metrologisch Instituut, (01-03/06/2016), Delft (Presentation)

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32. Salhi, M., Cakir, S., Cinar, M., Tektas, C.B., Cetintas, M. "GTEM Cell as an Alternative Method for Radiated Immunity Tests A comparison with an Anechoic Chamber", International Symposium and Exhibition on Electromagnetic Compatibility (EMC Europe 2016), Wroclaw (05-09/09/2016) : 6 p.

33. Mandaris, D., Cakir, S., Sen, O., Lorenzo, M.J., Lopez Sanz, D., Svoboda, M., Hamouz, P., Leferink, F. "Comparison of Active Levelling and Pre-Calibrating/Substitution Method for Radiated Immunity Testing of Large Equipment", International Symposium and Exhibition on Electromagnetic Compatibility (EMC Europe 2016), Wroclaw (05-09/09/2016) : 7 p.

34. Salhi, M., Sen, O., Cakir, S., Cetintas, M. "3D/2D Radiation Pattern Measurement of Different GSM Phones for EMC Applications", International Symposium and Exhibition on Electromagnetic Compatibility (EMC Europe 2016), Wroclaw (05-09/09/2016) : 6 p.

35. Tektas, C.B., Sen, O., Cakir, S., Cetintas, M. "Improvements in Alternative Radiated Emission Test Methods With Surface Wire", International Symposium and Exhibition on Electromagnetic Compatibility (EMC Europe 2016), Wroclaw (05-09/09/2016) : 6 p.

36. Unsal, B., Rathore, K., Koc, E. "Numerical Findings on the Boundary Layer Transition of Critical-Flow Venturi Nozzles", The 17th International Flow Measurement Conference (FLOMEKO 2016) Sydney (26-29/09/ 2016) 5p.
37. Unsal, B. "Flow Map for Critical Flow Venturi Nozzles", 6th Workshop on Critical Flow Venturi Nozzles (CFVN), (21/09/2016), Sydney (Presentation)
38. Bilgic, E., Mutaf, H., Kirbas, C., Sadikoglu, E. "Evaluation of Uncertainty Contributions of Measurement Surface and Number of Microphone Positions in Determination of Sound Power Levels", International Conference on Computational and Experimental Science and Engineering (ICCESEN 2016) , Antalya (19-24/10/2016) : 8 p.
39. Bilgic, E. "Determination of Pulse Width and Pulse Amplitude Characteristics of Materials Used in Pendulum Type Shock Calibration Device", International Conference on Computational and Experimental Science and Engineering (ICCESEN 2016), Antalya (19-24/10/2016) : 4 p.
40. Isleyen, A., Can, S.Z., Bilsel, M., Ari, B., Tunc, M., Binici, B., Gokcen, T., Naykki, T., Perkola, N. "A Joint Research Approach for the Development of Certified Matrix Reference Materials for Environmental Analysis-P-26", 20th International Scientific Conference (ECOBALT 2016), Tartu, Estonia (09-12/10/2016) : 1 p.
41. Topal, K. "Field Survey on Quality Control Tools for Criminal Laboratories", The International Association of Forensic Toxicologists (TIAFT 2016), (30/10-02/11/2016), Antalya (Presentation)
42. Topal, K. "VOC Analysis with TD-GC-MS : A comparison of Columns and Adsorbent Tubes", Mersin Üniversitesi, (15-21/08/2016), Mersin (Presentation)
43. Isleyen, A., Vogl, J., Nikolic, D., Jotanovic, A., Naykki, T., Perkola, N., Horvat, M., Zon, A., Bulska, E., Ochsenkuhn - Petropoulou, M., Can, S.Z., Bilsel, M., Hafner, K., Jacimovic, R., Gazevic, L. "Project Review: Matrix Reference Materials for Environmental Analysis", 2nd International Congress of Chemists and Chemical Engineers of B&H, Sarajevo (21-23/10/2016) : 1 p.
44. Liv, L., Uysal, E., Ficicioglu, F., Nakiboglu, N. "Preparation of Silver-Silver Chloride and Platinized Platinum Electrode for Primary pH Measurements", 10th Aegean Analytical Chemistry Days, Çanakkale (29/09-02/10/2016) : 1 p.
45. Liv, L., Nakiboglu, N. "Voltammetric Determination of Boron Using p-Xylenol Orange Modified Pencil Graphite Electrode", 10th Aegean Analytical Chemistry Days, Çanakkale (29/09-02/10/2016) : 1 p.

46. Uysal, E., Liv, L., Ficicioglu, F., Nakiboglu, N. "Production and Certification of Reference pH Buffer Solutions at National Metrology Institute of Turkey", 10th Aegean Analytical Chemistry Days, Çanakkale (29/09-02/10/2016) : 1 p.

47. Liv, L., Nakiboglu, N. "Voltammetric Determination of Boron in Eye Lotion and Water Samples Using Gold and Copper Nanoparticles and Multiwalled Carbon Nanotube Modified Electrode", Troia Kültür Merkezi, (29/09-02/10/2016), Çanakkale (Presentation)

48. Simsek, A., Isleyen, A., Topal, K., Goren, A.C. "Şekerli Gıdalar İçin Sertifikalı Referans Malzemeler", 5.Uluslararası Arıcılık ve Çam Balı Kongresi, (01-05/11/2016), Muğla (Presentation)

49. Dizdar, H., Vatan, C., Aydemir, B. "Kuvvet Ölçümlerinde Bağıl Enterpolasyon Hatasının Farklı Matematiksel Yöntemlerle Hesaplanması ve Sayısal Örneklenmesi", 1st International Mediterranean Science and Engineering Congress (IMSEC 2016), Adana (26-28/10/2016) : 9 p.

50. Aydemir, B., Vatan, C., Dizdar, H. "Malzeme Test Makinalarında Eksenellik Ölçümü ve Önemi", 1st International Mediterranean Science and Engineering Congress (IMSEC 2016), Adana (26-28/10/2016) : 7 p.

51. Fidan, E., Kucur, O. "Performance of Two-Way AF MIMO Relay Networks with Single and Multiple Antenna Selection Schemes ", 2016 IEEE 27th Annual International Symposium on Personal, Indoor, and Mobile Radio Communications (PIMRC) , Valencia (03-08/09/2016) : 6 p.

52. Gulnihar, K. "Evaluation of a PC-Oscilloscope Based Test Setup for Flicker & Harmonic Measurements with High Accuracy", EMC Europe 2016, (05-09/09/2016), Wroclaw (Presentation)

53. Gulnihar, K. "Design of a Programmable Round-Robin Test Device for Steady-State Harmonics", EMC Europe 2016, (05-09/09/2016), Wroclaw (Presentation)

54. Aydemir, B., Ozgen, D., Durgut, Y., Kucuk, O., Ozal, A.S., Tosun, I. "Dinamik Ölçümlerde Sensör Uygulamaları", 1st International Mediterranean Science and Engineering Congress (IMSEC 2016), Adana (26-28/10/2016) : 8 p.

55. Synthesis and Proporties of Conjugated Organic Molecule of Optoelectronic For Oled Application", Recep Isci, Okan Demirel, Turan Ozturk, International Workshop on Advanced Materials and Processes for Energy Applications, British Council, 20-24 April 2016, Istanbul-Turkey

56. "Synthesis and Optical&Electronic Proporties of Organic Molecules For Solar Cell", Sebahat Topal, Turan Ozturk, International Workshop on Advanced Materials and Processes for Energy Applications, British Council, 20-24 April 2016, Istanbul-Turkey

57. "Synthesis and Proporties of Conjugated Organic Molecules Based on DTT Derivatives Designed For Organic Electronic", Gözde Aydın, Mertcan Ozel, Ipek Osken, Turan Ozturk, International Workshop on Advanced Materials and Processes for Energy Applications, British Council, 20-24 April 2016, Istanbul-Turkey

58. "Synthesis and Optoelectronic Properties of Mono-Alkylated Thieno[3,2-b] Thiophenes and Their Polymers", Koray Tansu Ilhan, Sebahat Topal, Turan Ozturk, International Workshop on Advanced Materials and Processes for Energy Applications, British Council, 20-24 April 2016, Istanbul-Turkey

59. "Synthesis and Properties of Thienothiophene-Boron for Solar Cell Application", Recep Isci, Turan Ozturk, 27th International Symposium on Organic Chemistry of Sulfur (ISOCS 27), From fundamental research to application, 24–29.07.2016 - Friedrich-Schiller-University Jena, Germany

60. "1,1′-Biferrocenylene Based D—A—D Oligomers", Okan Demirel, Turan Ozturk27th International Symposium on Organic Chemistry of Sulfur (ISOCS 27), From fundamental research to application, 24–29.07.2016 - Friedrich-Schiller-University Jena, Germany

61. "Boron and Tetraphenylethene Substituted Thienothiophene P05 Possessing Molecules for OLED Applications", Pelin Ulukan, Turan Ozturk, 27th International Symposium on Organic Chemistry of Sulfur (ISOCS 27), From fundamental research to application, 24–29.07.2016 - Friedrich-Schiller-University Jena, Germany

62. "Donor-Acceptor Systems Possessing Tetraphenylethylene Substituted Dithienothiophene-S, S-dioxides for OLED Applications", Rengin Büşra Özek, Turan Ozturk, 27th International Symposium on Organic Chemistry of Sulfur (ISOCS 27), From fundamental research to application, 24–29.07.2016 - Friedrich-Schiller-University Jena, Germany

63. "Synthesis and Optoelectronic Properties of Mono-Alkylated Thieno[3,2-b]Thiophenes and Their Polymers", Koray Tansu Ilhan, Turan Ozturk, 27th International Symposium on Organic Chemistry of Sulfur (ISOCS 27), From fundamental research to application, 24–29.07.2016 - Friedrich-Schiller-University Jena, Germany

64. "1,1'-Biferrocenylene Based D-A-D Oligomers", Okan Demirel, Rochus Breuer, Mehmet Emin Cinar, Michael Schmittel, Turan Ozturk, Macro 2016 - 46th IUPAC World Polymer Congress, Istanbul 17-21 July
65. "Triphenylmine and Tetraphenylethylene Substituted Thienothiophene for OLED Applications", Garen Suna, Sebahat Topal, Turan Ozturk, Macro 2016 - 46th IUPAC World Polymer Congress, Istanbul 17-21 July
66. "Boron and Tetraphenylethene Substituted Thienothiophene Possessing Molecules for OLED Applications", Pelin Ulukan, Turan Öztürk, Macro 2016 - 46th IUPAC World Polymer Congress, Istanbul 17-21 July
67. "Synthesis and Optoelectronic Properties of Mono-Alkylated Thieno[3,2-b] Thiophenes and Their Polymers", Koray Tansu Ilhan, Sebahat Topal, Turan Ozturk, Macro 2016 - 46th IUPAC World Polymer Congress, Istanbul 17-21 July
68. "Thienothiophenes (TT) and Dithienothiophenes (DTT) for Organic Materials", T. Ozturk, 27th International Symposium on Organic Chemistry of Sulfur (ISOCS 27), From fundamental research to application, 24–29.07.2016 - Friedrich-Schiller-University Jena, Germany
69. "Thienothiophene (TT) and Dithienothiophene (DTT) Heterocycles", Turan Ozturk, FloHet-2016, Florida Heterocyclic & Synthetic IUPAC-Sponsored Conference, University of Florida, Gainesville, USA. Feb. 28 to March 2, 2016
70. "Thienothiophenes (TT) and Dithienothiophenes (DTT) for Electronic and Optoelectronic", Turan Ozturk, Macro 2016 - 46th IUPAC World Polymer Congress, Istanbul 17-21 July
71. "Thienothiophenes (TT) and Dithienothiophenes (DTT) for Electronic and Optoelectronic" Turan Ozturk, International Workshop on Advanced Materials and Processes for Energy Applications, 20-24 April 2016, Istanbul-Turkey, Organized by: British Council, Dr. Derya Barana, Dr. Christian Nielsena, Dr. Cenk Aktas, Prof. Iain McCulloch

National Publications

29 articles were authored or co-authored by TÜBİTAK UME researchers for national publications and conferences in 2016.

1. Goren, A.C. "Türkiye'de Ulusal Marker Uygulaması: 10 YIL", Anahtar, 1:325 (2016) : 17-21
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2. High Accuracy Pressure Transducer with Improved Thermal Stability (Rıfat Kangı) (dated 28.12.2016 and granted protection under patent application number 2016/19943)

GLOSSARY

Metrology(*)

science of measurement and its application

Measurement(*)

process of experimentally obtaining one or more quantity values that can reasonably be attributed to a quantity

Measurement Accuracy(*)

closeness of agreement between a measured quantity value and a true quantity value of a measurand

Calibration(*)

operation that, under specified conditions, in a first step, establishes a relation between the quantity values with measurement uncertainties provided by measurement standards and corresponding indications with associated measurement uncertainties and, in a second step, uses this information to establish a relation for obtaining a measurement result from an indication

Measurement Uncertainty(*)

non-negative parameter characterizing the dispersion of the quantity values being attributed to a measurand, based on the information used

Primary Measurement Standard(*)

measurement standard established using a primary reference measurement procedure, or created as an artifact, chosen by convention

Metrological Traceability(*)

property of a measurement result whereby the result can be related to a reference through a documented unbroken chain of calibrations, each contributing to the measurement uncertainty

Calibration Certificate

A document produced at the end of a calibration, containing information on the measurement standards and reference instruments used, the calibration method and procedure, environmental conditions, measurement results and uncertainties and which establishes traceability to the national measurement standards that realize SI units.

(*) International vocabulary of metrology – Basic and general concepts and associated terms (VIM) (JCGM 200:2012, 3rd edition)

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UME

FAST FORWARD INTO THE FUTURE WITH MEASUREMENTS!

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