Creating a New Future, Leading a Better Life
Korea Research Institute of Standards and Science

www.kriss.re.kr
As the national metrology institute (NMI) of Korea founded in 1975, KRISS develops measurement standards technologies that underpin all sorts of scientific, technological and industrial activities and provides technology services at home and abroad. As such, KRISS has paved a way for the nation’s science and technology (S&T) development and played a central role in upgrading the quality of Korea’s key industrial products to a global level.

KRISS has solidified its presence as a world-leading NMI, while scaling up strategic partnerships with international metrology organizations and institutes in both advanced and developing countries, driven by its top-notch technological prowess. KRISS continues improving itself as a world-class NMI by intensifying and spearheading its leadership within the international metrology community. In addition, KRISS is strengthening strategic cooperation with advanced countries to develop next-generation measurement technologies while actively participating in Official Development Assistance (ODA) projects to transfer its know-how, which served as the foundation of where it stands today, to developing countries as a benchmark model to develop national standards.

KRISS is setting the world’s standards for mankind to enjoy a happy and enriching life. KRISS is making a future where dreams come true in a healthy and heart-warming world driven by the accurate metrology anyone can trust.
MISSION

Being a beacon of light for the happiness of people

Mission
As a government-funded research institute, KRISS has provided the foundation for the advancement of science and technology through the establishment of national measurement standards, R&D of measurement technologies, and dissemination of national measurement standards. KRISS has contributed to stronger development of national S&T, higher national industrial competitiveness and a better quality of life for the people.

“Establishment of National Measurement Standards for Convenience and Safety in the Society”
Contributing to creating a society with confidence, safety and reliability by establishing national measurement standards that enable everyone to measure, produce and trade products based on the equal standards
Establishing standards in 770 fields among a total of 1646 national measurement standards (as of 2015)

“Research on Measurement Technologies that Lead the S&T Development”
Leading the S&T innovation and the development of national strategic industries by conducting R&D on new and better technology for measurement standards and measurement technologies for emerging industries.
Transferring 56 technologies (as of 2015)

“Improvement in Measurement Capabilities in Industries”
Providing calibration and testing services and supplying certified reference materials (CRM) for various instruments used in industries to maintain accurate measurement values.
Providing approximately 9,760 instrument calibration services and 2,312 testing services, and supplying 3,635 CRMs (as of 2015)

LEGAL GROUNDS

Article 127.2 of the Korean Constitution
The state shall establish a national standards system.

Article 13.1 of the Framework Act on National Standards
The Korea Research Institute of Standards and Science, established pursuant to the Act on the Establishment, Operation and Fostering of Government-Funded Science and Technology Research Institutions, shall serve as the representative institute of national measurement standards.

ORGANIZATION AND BUDGET

Incomparable experts create the highest synergies.

Nestled in the Daedeok Research Complex on a land of 500,147 m²-wide site, KRISS is home to about 440 employees and making every effort as the NMI of Korea with its employees.
KRISS has strived to become a global leading NMI for the past 40 years.

In the 1970s
Birth of Measurement Standards
Dec. 24, 1975 Established as Korea Standards Research Institute
Mar. 1978 Moved into the Daedeok Research Complex (currently, INNOPOLIS Daedeok) as the first tenant institute
Dec. 1978 Commenced the national calibration and testing operations

In the 1980s
Supporting National Infrastructure
Jul. 1982 Opened the Precision Measuring Instrument Repair Center to enhance the industrial competitiveness
Nov. 1984 Opened the Standard Time & Frequency Broadcasting Station (HLA) that triggered the establishment of national standards in the field of temporal frequency

In the 1990s
Efforts to Boost the National Industrial Competitiveness
Oct. 1991 Renamed as Korea Research Institute of Standards and Science (KRISS)
Nov. 1994 Completed the construction of a building for new materials evaluation and an open area test site for electromagnetic waves
Feb. 8, 1999 Officially designated as the National Metrology Institute (NMI) in the Framework Act on National Standards
Oct. 14, 1999 Signed the CIPM Mutual Recognition Arrangement (CIPM MRA)

In the 2000s
Leading the 21C Measurement Standards
Jan. 2001 Opened the Vacuum Technology Center
Sep. 2001 Completed the construction of a building for Structural Integrity Measurement
Dec. 2004 Redefined air density through the measurement of Argon concentration in the air
Sep. 2005 Hosted the 21st APMP General Assembly and Related Meetings

In the 2010s
Toward the World-leading NMI
Jun. 2011 launched the new ODA project, “UNIDO Training Program in Metrology” for 3 years
Oct. 2011 Hosted the World Calibration Center (WCC) for atmospheric SF6
Oct. 2011 Developed the world’s first rice CRM for measurement of radioactivity in rice
Oct. 2012 Organized the 20th IMEKO World Congress
Mar. 2013 Elucidated mechanisms underlying protein complex dynamics
Mar. 2013 Newly affiliated with Korea Research Council of Fundamental Science and Technology under the Ministry of Science, ICT and Future Planning

In the 2000s
In the 1990s
In the 1980s
In the 1970s

Jan. 2007 Domestically produced the High Resolution Scanning Electron Microscope (SEM)
Oct. 2007 Developed the diagnosis technology for myocardial ischaemia diseases based on magnetoangiography (MAG)
Jul. 2008 Developed Korea’s first optical pumping Atomic Beam Frequency Standard (KRISS-1) using exclusively domestic technology
Nov. 2009 Developed the on-line monitoring system for greenhouse gases (GHG)
Apr. 2010 Launched the KRISS’ World Class Lab (WCL) program

May 2013 Succeeded in manipulation of thermal conductivity in graphene
Jun. 2013 Developed the holistic haptic mouse for displaying virtual haptic sensations
Jul. 2013 Developed the world’s first atom-resolved microscopy by using thermoelastic effect
Dec. 2013 Developed an atomic brain magnetometer system
Feb. 2014 Developed the optical lattice clock with the Ytterbium (Yb) atom
Jun. 2014 Newly affiliated with National Research Council of Science & Technology under the Ministry of Science, ICT and Future Planning
Sep. 2014 Hosted the 30th APMP General Assembly and Related Meetings
Oct. 2014 Developed the hyperfine narrow graphene nanoribbons
Nov. 2014 Developed the 2 m diameter reflector for space development
INTRODUCTION OF THE R&D DIVISION

Metrology as the basis for all sciences is critical to ensure the sophistication of science and technology and the advancement of industries. KRISS now strives to become a research institute that leads the world with best-in-class technologies, hoping to see Korea as the world's top-notch nation in science.
The Division of Physical Metrology is responsible for setting and maintaining national measurement standards for SI base units, that is, length (m), mass (kg), time (s), electric current (A), thermodynamic temperature (K), amount of substance (mol), luminous intensity (cd), and their derived units. It does the utmost to enhance its measurement capabilities. These units serve as the basic ones for the fairness of commercial transactions as well as core scientific research and the production of advanced products. The division also focuses on developing new standards for emerging industries.

**R&D HIGHLIGHTS**

The Center for Thermometry in the Division of Physical Metrology accomplished measurement the molar mass of argon for the determination of the Boltzmann constant. The determination of the Boltzmann constant has been the biggest issue in the international community of thermometry for the past 18 years, because the constant will be used for the redefinition of the kelvin by fixing the numerical value to the constant. For this, the constant needs to be measured as precisely as possible under the current definition before the scheduled change occurs in 2017. Among several methods to determine the Boltzmann constant, acoustic gas thermometry has provided the most precise results from several NMIs. However, two recent determinations that claimed the smallest uncertainties have shown a relative discrepancy of more than 2.7 x 10^-5, a difference much larger than required for the redefinition of the kelvin (less than 1 x 10^-8). The Center for Thermometry, in collaboration with the Center for Gas Analysis (Div. of Metrology for Quality of Life) and three other NMIs, revealed that the discrepancy was originated from the measurement of the molar mass of argon used for the Boltzmann constant determinations. As a result, the discrepancy issue was resolved and the new adjustment of the Boltzmann constant came out with a relative uncertainty of 5.7 x 10^-10. This contribution from KRISS was critical to remove the obstacle to the redefinition of the kelvin and made it possible to proceed with the redefinition of the kelvin as scheduled along with the redefinition of three other SI base units (i.e., kilogram, ampere and mole). The result was published in the Metrologia in October 2015 and selected by the publisher as one of the highlights of 2015.

The Division of Metrology for Quality of Life researches on measurement technologies for ensuring a happier and richer life. The division serves as the national reference laboratory especially for the fields of environmental protection, health care sectors, food safety, and safety assessment of infrastructures. The division is contributing to a higher quality of life for people by providing CRMs, and testing and calibration operations to industrial sites, as well as allowing for regulations on measurement capabilities of global levels.

**R&D HIGHLIGHTS**

Development of primary methods for protein measurement: no more tricks that would threaten people's health! You may remember the “fake milk scandal” in 2008; milk and infant formulas were added with melamine in an illegal attempt to increase their apparent protein content. Such terrifying outcome could have been prevented if more accurate measurements were available for the quantification of protein content. To this end, the Center for Bioanalysis in the Division of Metrology for Quality of Life has carried out project “Development of Protein Measurement Standards” from 2010 to 2014. The research team has developed successfully an accurate and reliable protein measurement system, which includes primary measurement methodologies and certified reference materials (CRM) for a model protein, human growth hormone. The first primary methodology developed by the research team is based on the analysis of amino acids constituting the protein. In addition, through the collaboration with the Center for Inorganic Analysis in the division, the center has developed a novel element-based protein measurement methodology, where protein quantities could be measured based on sulfur content in the proteins. With the successful completion of the project, KRISS now possesses two independent primary methodologies and established its original technology pipeline for the production of protein reference materials. The pipeline includes producing stable isotope-labeled proteins as a gold standard for peptide-based quantification of specific proteins. Building upon successes in establishing protein measurement standards, KRISS will endeavor to develop next-generation measurement methodologies targeting a variety of trace-level proteins in complex matrices.
DIVISION OF INDUSTRIAL METROLOGY

Spearheading at the forefront of enhancing industrial competitiveness in Korea

The Division of Industrial Metrology strives to develop measurement technologies required to sharpen the competitive edge of the nation’s key industries and new growth drive industries. A measurement standard system is set up to validate the measurements outcomes of domestic materials. Also, efforts are underway to develop characteristic evaluations of nanomaterials, vacuum measurement standards, high-resolution satellite optics, safety technologies and advanced measuring instruments.

R&D HIGHLIGHTS

Developing the ultra light-weight reflector for aerospace: emerging as a new leader in the era of aerospace

Good eyesight would make the world be seen as a clearer and more diverse one. The artificial satellite used in our daily lives, in fact, would offer more benefits to us. It is the core component that determines the resolution of the image shot by a reflector, which is analogous to the eye of this artificial satellite. The longer the diameter of the reflector, the clearer the images. However, being loaded on an artificial satellite is subject to limitations in size and weight, so for a commercial satellite, a reflector with the maximum diameter of 1 m is to be used. Center for Space Optics at the Division of Industrial Metrology produced a reflector with the diameter of 0.8 m in 2013, driven by the ultra-precision optical measurement and production technology of the past 10 years, through which an ultra-lightweight aerospace reflector was successfully developed with a diameter of 1 m. The team increased the weight reduction rate from 60 % to 80 % to lower the reflector weight, while decreasing the thickness of the easily breakable glass material by half. In order to complement the weakness of a lower performance, the mechanical structure supporting the reflector was newly designed, so the reflector modification resulting from gravity could be scaled down to less than 10 nm. There is an inevitably high demand for a reflector with a high resolution in the global artificial satellite market that grows every year. The Center for Space Optics makes every effort to realize the goal of developing an artificial satellite in line with the plan to launch Korea Multi-purpose Satellite No.7 in 2020.

DIVISION OF METROLOGY FOR FUTURE TECHNOLOGY

Fostering the energy of hopes to spearhead the cutting-edge world

The Division of Metrology for Future Technology conducts R&D on cutting-edge convergent technologies that will act as the spearhead of the nation’s advancement and strengthen the nation’s competitive edge. The division developed measurement standards based on single quantum and convergent technologies in the field of nano and bio cognitive science, thereby preparing for the precision measurement needs of new future industries.

R&D HIGHLIGHTS

Responding to the brain functional connectivity, the hottest issue in brain science

If you think of brain functional mapping, you might first think of the fMRI (functional MRI). However, you will consider brainwave magnetic resonance (BMR) from now on because the Center for Biosignals has developed a new-concept modularity for imaging of brain functions using the magnetic resonance image for brain waves. The existing alternative was the fMRI which utilizes the degree of oxygen consumption in blood from neuronal activity to image the brand function indirectly. Its limitations were found in identifying the brain functional connectivity that rapidly changes due to the time delay of a couple of seconds. Moreover, the stronger the performance, the higher the price for the instrument, and the stronger the exposure to the magnetic field and electromagnetic waves, thus doing harm to the body. However, BMR enables the identification of the brain functional connectivity, even in a low magnetic field, because the oscillatory neuro-magnetic field can resonate the protons in the brain. This technology will not only be a key to untangling what is known of the brain, but is also a domestically developed technology, which will contribute to intensifying the national competitiveness in the global market for expensive medical instruments. Moreover, high hopes may be pinned on Korea leading the global biomagnetic resonance research of various categories.
TECHNOLOGY SERVICES
Taking the lead in boosting the industrial competitiveness

Dissemination of Standards and Knowledge on Measurement
As the National Metrology Institute for dissemination of the International System of Units, KRISS runs the Division of Technology Services as an exclusive unit to disseminate measurement standards, offering calibration and testing services and CRMs worldwide. These services contribute to boosting the quality of industrial products, especially in semiconductors, shipbuilding and aerospace in Korea to befit that of the international level.

KRISS also operates training courses in metrology to transfer KRIS’s exclusive cutting-edge measurement technologies and knowledge, and know-how on measurement for the workforce involved in industries, academia, institutes and developing country’s NMIs. This paves the way for intensifying the national industrial competitiveness by seeking to scale up the level of precision measurement technologies in domestic industries.

SME Boosting Service
KRISS has been providing a variety of technology service programs for its clients in ways that promote the effective and efficient dissemination of national measurement standards and technologies across the nation. Our technology service programs consist of R&D collaboration, technology transfers and commercialization, and networking activities. These services are offered through open networks with thousands of client organizations, which include industry, academia, and research institutes.

<table>
<thead>
<tr>
<th>Type</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
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</thead>
<tbody>
<tr>
<td>Calibrations</td>
<td>13,353</td>
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<td>12,585</td>
<td>12,055</td>
<td>11,179</td>
<td>9,760</td>
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<td>2,250</td>
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<td>2,106</td>
<td>2,307</td>
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<tr>
<td>CRMs</td>
<td>3,437</td>
<td>3,095</td>
<td>3,134</td>
<td>3,404</td>
<td>3,604</td>
<td>3,635</td>
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</table>

01. Hidden Champion Fostering Program
KRISS supports the Korean economy through programs that provide stepwise plans for SMEs to resolve technical obstacles and streamline manufacturing processes. KRISS plans to foster ‘Hidden Champions’ with high growth potential in the global market.

02. Home Doctor Program
KRISS operates a Home Doctor Program in which its specialists offer one-on-one customized technical support for would-be entrepreneurs.

03. Measurement Club
KRISS is a network of measurement experts, industrial users, equipment manufacturers. Currently 6,000 members are participating in 24 diverse club areas, such as pressure, X-ray diffraction, hardness, surface analysis, antenna and temperature-humidity, etc. KRISS effectively transfers measurement know-how to SMEs through various activities.

04. Startup Incubator Program
KRISS operates the Startup Incubator Program to contribute to building startup-friendly environments. KRISS plays a role in promoting startup-friendly business culture with a range of support for the design and production of pilot products, thereby ensuring that potential entrepreneurs’ ideas can be materialized as a startup business and subsequently commercialized.
Securing international equivalency of national standards is key to ensuring national competitiveness in the era of globalization. KRISS is expanding its role as the global metrology network hub with its internationally recognized measurement capabilities.
INTERNATIONAL COOPERATION

A global network connecting 40,000 km

As the NMI of Korea, KRISS is dedicated to improving the qualitative level of Key Comparison (KC), conducting activities as an international metrology specialist at conferences held by international bodies in metrology, and strengthening cooperation with overseas NMIs in advanced and developing countries. Over the last decade, KRISS has improved international recognition on Korea’s technological prowess in metrology and strengthened Korea’s global leadership in the field of international standards.

Global Leadership of KRISS

Representing Korea as a signatory to the Meter Convention, a multilateral international treaty, KRISS has enhanced Korea’s international prestige as a member of the CIPM (International Committee for Weights and Measures), which leads international activities in metrology with its nine Consultative Committees. KRISS successfully hosted the General Assembly and Related Meetings of the APMP (Asia-Pacific Metrology Programme) in 2005 and 2014. KRISS also confirmed its leadership by holding the titles of the APMP chair and secretariat for two years from November 2007. Moreover, KRISS has been actively participating in development aid programs in metrology in Asia, Africa and Latin America, while establishing itself as a global leader in metrology, as well as a partner for mutual benefits and a benchmarking model.

Competencies Proven through Key Comparisons

Key Comparison (KC) is an international comparison of key measurement standards and is recognized as the largest international cooperation program in metrology. Four international organizations, including the IAEA and the WMO, and 97 countries have joined the CIPM MRA (Mutual Recognition Arrangement) since its adoption in October 1999. While equipping itself with quality management systems befitting international standards to fulfill the CIPM MRA requirements, KRISS has been continuously engaged in KCs. As of 2015, KRISS has participated in 395 categories.

CCQM-K55: Mass fraction of Valine

Degrees of equivalence, D and expanded uncertainty U(k = 2)

<table>
<thead>
<tr>
<th>Country</th>
<th>Pilot Lab.</th>
<th>Country</th>
<th>Participation</th>
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<tbody>
<tr>
<td>Germany</td>
<td>175</td>
<td>Germany</td>
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<tr>
<td>United States</td>
<td>117</td>
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<td>491</td>
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<tr>
<td>United Kingdom</td>
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<td>96</td>
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<td>473</td>
</tr>
<tr>
<td>France</td>
<td>71</td>
<td>Korea, Republic of</td>
<td>461*</td>
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<tr>
<td>Russian Federation</td>
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<tr>
<td>Australia</td>
<td>25</td>
<td>Italy</td>
<td>287</td>
</tr>
</tbody>
</table>

* The number includes 6 KCs carried out by other institutes

KEY COMPARISON

The cross-comparison program for measurement outcome conducted by NMIs in different countries by sector to secure international equivalence.

- Holding measurement capacities of international level is a prerequisite to participate in the KC organized by CIPM.
Building cooperative networks with Global Partners

While leading cooperation in metrology in the Asia-Pacific region, KRISS continues to expand the horizons of international cooperation. KRISS seeks for close global partnerships with over 40 institutes, including two international metrology organizations and six regional metrology organizations. KRISS is engaged in various cooperation activities, including joint seminars, meetings of institutional heads, technology transfer and joint research, not only with the NMIs in advanced and developing countries, but also with the world-renowned universities and companies.

Global Metrology Academy_ A Program for Development of Measurement Specialists

The Global Metrology Academy (GMA) was formed in 2013 to develop human resources in metrology. GMA conducts global measurement training for groups and individuals on a yearly basis to share knowledge and experience with metrology community all over the globe. The GMA training programs put a special emphasis on physical/chemical measurement and quality management system.

http://gma.kriss.re.kr

FOR INQUIRIES
GMA (sweeo@kriss.re.kr, Tel. +82-42-868-5440)

KRISS-UST Graduate School of Metrology

KRISS operates a Graduate School of Metrology in cooperation with the University of Science and Technology (UST). The Graduate School of Metrology offers master and doctoral courses in measurement science and technology to foster highly qualified R&D professionals through on-site education. Student-oriented customized courses are offered by utilizing KRISS’ facilities and workforce.

www.ust.ac.kr

“KRISS PARTNERS WITH BILATERAL AGREEMENTS”

“Better Standards, Better Life”

KRISS will make each and every effort to leap into a top-tier metrology research institute, a metrology convergence research institute, and a supplier of measurement technologies to respond to social issues. KRISS also strives with its utmost endeavors to serve as ‘a research institute for people,’ garnering trusts from the public as something that Korea can be proud of.

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