



Measurement matters



Measurement matters

How could you do the following everyday activities without measurement?

• catch a train



• buy petrol

• have an x-ray



• build a bridge

• travel by aeroplane



• use your mobile

Measurement is everywhere, playing a vital role in our lives. Find out more about the role of measurement and the infrastructure provided by the National Measurement System.



Why is measure

Measurement underpins the welfare of a modern society and touches almost every part of daily life:

- **Ensuring the safety and effectiveness of healthcare diagnostics and treatments**
- **Measuring the composition, energy value and quantity of gas piped to our homes, or of fuel in our vehicles**
- **Ensuring safe operation of aircraft in flight**
- **Ensuring consistency of international time standards so we can communicate reliably and navigate accurately throughout the world**
- **Quantifying emissions of greenhouse gases to understand and mitigate climate change**
- **Ensuring the security and sustainability of our food supply**
- **Ensuring fairness between buyers and sellers in markets where goods are sold by weight or volume**

Measurement plays a fundamental part in the innovation process. To develop new products and processes, companies need to measure quantity, quality and performance. To trade successfully, companies utilise a regulatory framework, based upon measurement confidence, ensuring access to global markets that are fair and open and without unnecessary barriers to trade. Supporting this is an established infrastructure of traceable measurement linked seamlessly to the national standards maintained on behalf of the UK.

In some industries the need for accurate measurement is critical. For example, companies manufacturing precision engineering components used in aero engines will be working to tight specifications and must be able to measure size, material composition and performance to very accurate levels.

For many of us a visit to a hospital may not be desirable, but knowing that the treatment has been appropriately measured throughout its development, trials and final delivery to the patient, is vital to confidence in its application and effectiveness.

Measurement provides structure, removes chaos, reduces waste, ensures open and fair markets, supports precision where required and saves lives, money and time.



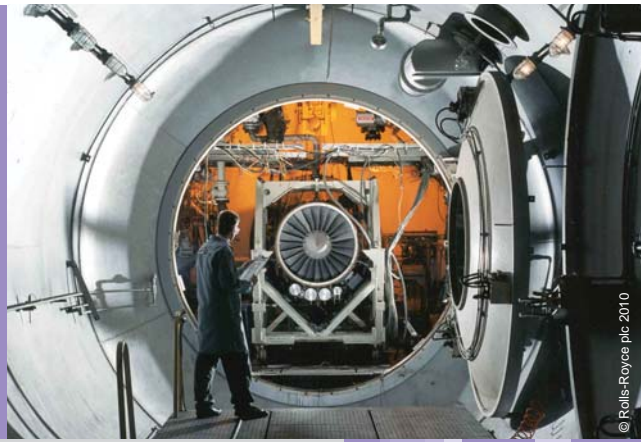
ment important?

Rolls-Royce

Rolls-Royce use over 200,000 items of measurement equipment. Rolls-Royce is critically dependent upon capable measurement.

“The support of the NMS is central to the company’s ability to deploy best practice in measurement and to continuously improve product and business performance.”

Pete Loftus, Head of Measurement Capability, Rolls-Royce



Confidence in trade

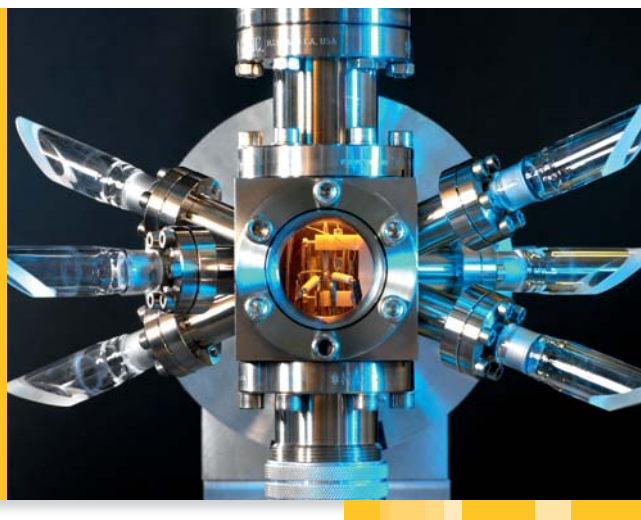
The National Measurement Office (NMO) ensures the UK’s system of weights and measures is fair, accurate and legal so that consumers and businesses have confidence whenever they buy and sell by quantity. Each year in the UK, £622 billion worth of goods and utilities are sold on the basis of the measurement of their quantity¹. NMO supports Ministers in their responsibility for the legislation that governs the accuracy and fairness of these transactions and for approving weighing and measuring instruments, such as petrol pumps. Every time you fill up your car with petrol, NMO, working with local Trading Standards Officers, ensures that the quantity you receive is accurate and within legally controlled tolerances. The value of most supermarket products sold can only be determined if the customer is able to compare the price per unit quantity, e.g. £ per kg or £ per litre. NMO ensures that all quantity statements and unit-price calculations are accurate.

¹Analysis of the Economics of Weights and Measures Legislation, Deloitte June 2009.



The time according to the NMS

The NMS programmes provide time standards for the UK and contribute to the international definition of Coordinated Universal Time. NPL maintains these standards and is responsible for the accuracy of the radio signal which is used to set the nation’s clocks. Accurate time is essential for keeping the modern world working - global navigation systems, the internet, e-mail, television, the power industry, transport, and financial systems all depend critically on time measurement. The broadcast time signal is accurate to within one millisecond of Coordinated Universal Time and supports a wide range of services. These include emergency 999 communications, train companies, cash machines and mobile phone billing systems.



Measurement m

Measurement plays a vital role in ensuring quality of life for UK citizens. Accurate measurement is key in developing, testing and administering health treatments. The NMS supports measurement of the environment, from climate change to air quality and from posting letters to pulling pints. The network of trading standards officers oversee thousands of measurements every day, ensuring a fair legal measurement system.

Environmental monitoring

NMS programmes, through NPL, supported the Environment Agency to establish their environmental Monitoring Certification Scheme (MCERTS). This was initially developed to enable operators to self-monitor stack emissions with reliability using certified continuous monitoring systems. It is now used for Operator Monitoring Assessment and monitoring emissions to air, land and water. LGC supports MCERTS through provision of certified reference materials the benefits include: international recognition of certifications, certified instruments that are compliant with EU Directives and cost-effective collection of accurate and reliable emission data for regulators.



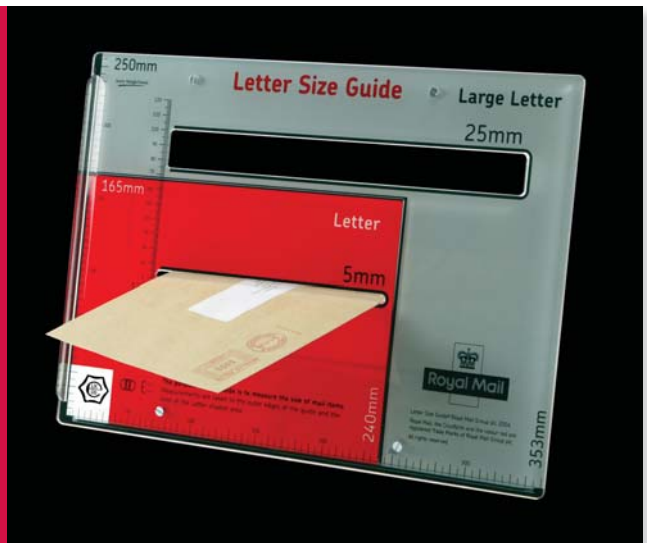
Simple and accurate pricing

Every working day - Royal Mail processes over 70 million items to 28 million addresses

Each week - Royal Mail serves over 21 million customers through its network of around 12,000 Post Office branches

Each year - Royal Mail handles some 400 million parcels.

With letters and packets now being priced by size, thickness and weight, it is vital that customers can easily work out prices. NMO helped Royal Mail develop a plastic size guide (seen in the photo here) so customers could easily see which category their mail falls into. It was essential that the plastic frames were exactly the right size so NMO used laser measuring technology to ensure that the prototype was accurate – the finished results can be seen on almost every Post Office counter across the UK.



Confidence in measurement

180,000 patients receive radiotherapy treatment for cancer in the UK each year and successful treatment is reliant upon the dosage standards delivered by the National Measurement System.

makes a difference

Improving cancer treatment

NMS and the Department of Health jointly funded a facility for NPL's new clinical linear accelerator in a £6 million investment that will allow hospitals to deliver more accurate, and more effective, radiation doses to cancer patients.

"I am absolutely convinced that this facility will play an important part in ensuring radiotherapy in this country is of the highest quality and contributes to the overall fight against cancer."

Professor Mike Richards
National Clinical Director for Cancer
at the UK's Department of Health



Measuring the wind of change

The UK's ambitious climate change agenda will only be achieved with a focus on well-engineered, efficient, renewable energy technologies. Wind turbine technologies are a key element of this strategy and, most recently, NMS has been supporting the development of wind turbines through improved metrology. This support, along with investment from the Department of Energy and Climate Change (DECC), has allowed the development of appropriate standards and the establishment of the National Wind Metrology Centre at TUV NEL. Manufacturers and developers can now use the Centre to obtain certification of wind turbines under DECC's Microgeneration Certification Scheme.



Measuring selenium

Selenium is a key element for good health, with benefits as diverse as antioxidant defence, thyroid function and the treatment and prevention of cancer. However, there is a fine line between beneficial levels and those that are toxic. The uptake and metabolism of selenium by the human body is dependent on its chemical form. LGC scientists are devising reference methods and standards to identify and measure selenium species to enable the development and characterisation of novel selenium foods and supplements. This has increased the integrity of the products and satisfied the concerns and interests of suppliers seeking to distribute a UK-first in selenium-enriched (functional) foods with potential for export and significant health benefits to consumers. LGC's speciation capability is now being extended to the measurement of selenium metabolites in cells and biological fluids in order to study the effect of selenium drug supplements on cancer patients.



Measurement h

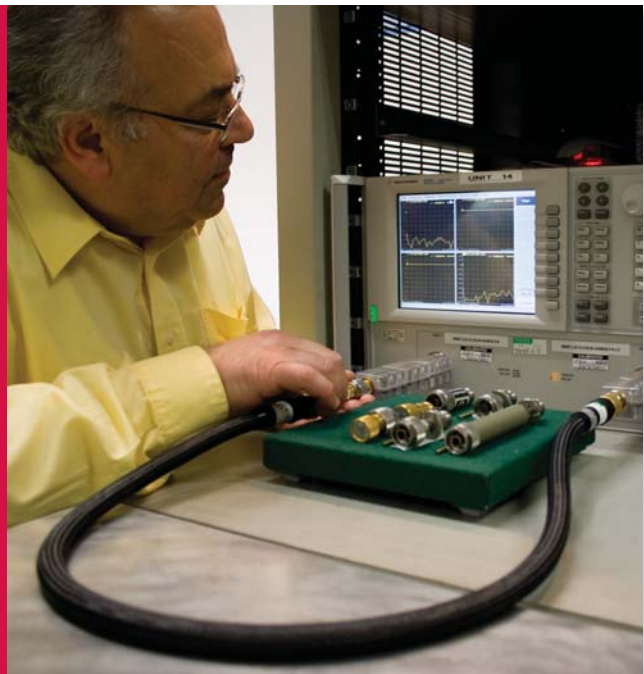
Measurement plays a fundamental part in the innovation process. To develop new and improved products and processes, companies are looking for:

- **improvements in quality or performance**
- **reductions in waste**
- **use of new materials or techniques**

All of these require appropriate measurement support. For many organisations, their first interaction with measurement is through the route of compliance with a standard. NMS expertise forms an input to over 800 standards committees to ensure that the measurement requirements are appropriate and that there is an infrastructure in place to enable organisations to demonstrate compliances.

NMS accuracy in the Laboratory

NPL has developed the 'industry' Primary Impedance Microwave Measurement System – iPIMMS. This new software provides businesses with NMS-levels of measurement accuracy that minimises downtime by ensuring instruments do not need to leave the workplace to be calibrated. Agilent Technologies, a global measurement instruments manufacturer, is one user. "We have chosen our facility in Winnersh near Reading to be our main European metrology laboratory. We use this to perform calibration of customer instruments as well as our own test standards such as calibration and verification kits. Having the iPIMMS system on site enables us to perform measurements in our own lab that previously we would have had to send out to NPL," says Agilent's Mike Horsefield, COE Laboratory Supervisor at Winnersh. "This means that we can deliver a faster and higher performance service to our European customers as well as get better utilisation out of our own equipment. In the end that saves us a lot of time and money and allows us to offer a commercial service that our customers were only able to get from national labs before."



In an independent survey*, companies that had improved their measurements said they benefited from:

- an increase in productivity
- improved quality
- greater customer satisfaction
- higher profits

A single year of NMS funding helps business to achieve annual financial benefits of £712 million.

(*National Measurement System Impact Assessment, conducted by Databuild Ltd.)

helps innovations

Shared confidence in the way ahead

The UK is still very dependent on the production of oil and gas. To facilitate further production, NEL is helping an increasing number of smaller companies to share existing infrastructure and produce non-conventional fluids which present new measurement challenges.

Recent research supported by the NMS has ensured that the energy industry has renewed confidence in density measurements of oil flows at non-standard conditions, since small discrepancies amount to millions of pounds in revenue for both the industry and government. DECC, who regulate the industry, are now issuing new guidelines based on the outputs from the research.



Intelligent harvesting robot

NPL is developing an intelligent crop-harvesting machine that could save an average UK farm at least £100,000 every year by letting them know when their crops are perfectly ripe. The 'robot' will use specialised imaging techniques to look beneath the leafy outer layers of crops like cauliflowers to check the size of the harvestable vegetable. NPL is one of the few places in the world with the expertise and equipment to take on this kind of technical challenge. It is hoped that this intelligent harvesting robot will improve farms' productivity and ultimately benefit consumers through cheaper food, and it will benefit the environment by reducing the amount of watering, fertiliser and pesticides used. NPL's research was recently nominated in the first ever 'iawards', celebrating the best of British science, innovation and technology.



New DNA screening approach for detecting nut allergens

In the UK, 1.5 million people suffer from food allergies. In order to improve quality of life and reduce the impact on the NHS, there is a need for food producers and suppliers to be able to develop 'allergen free' product lines, accurately label food products and minimise cross contamination during manufacture. In response to this, LGC, in collaboration with the food industry and regulators, has developed a sensitive and accurate DNA based screening approach for the detection of allergenic nuts in food that will benefit consumers through improved assurance of food labelling and ultimately reduce adverse reactions to food products.



Responding to g

The NMS has identified a set of challenges where it can support industry. The challenges are linked to government priorities and include:

Security – utilising measurement to combat security threats from either natural or malicious sources

Digital economy – keeping measurement capability and its infrastructure at the forefront of the fast moving communications and ICT industries

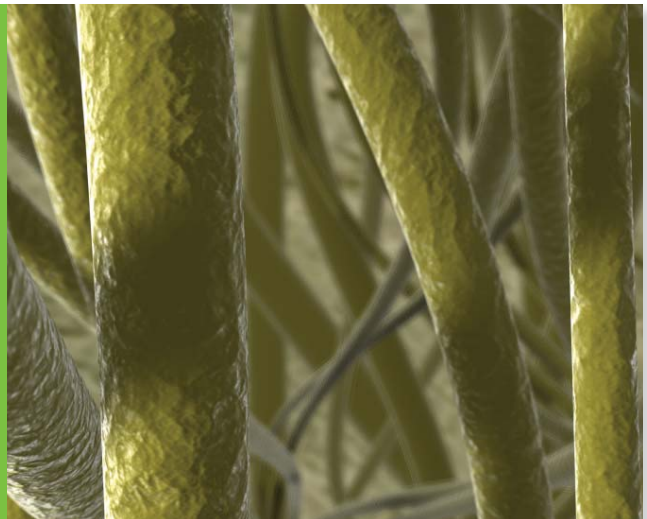
Energy – developing next generation products and supporting the low carbon economy

Healthcare – tackling diseases associated with our aging population and bringing best practice to clinical measurement

Sustainability – ensuring the use of efficient materials and supporting the infrastructure of recycling and reuse

National security

LGC scientists are developing new forensic methods for tracking the recent geographical movements of individuals to provide a powerful tool for international law enforcement. For the first time, the potential of measuring sulfur isotope variations, from a single hair strand, has been demonstrated as an indicator of an individual's recent geographical movements. Due to hair growth over time, each sample gives a chronological record of recent variations right up to point of analysis and samples can be collected covertly and non-invasively, without consent (as opposed to DNA), with only a single strand being required. Interest from security, police & forensic services signifies potential for this approach to be used in combination with DNA fingerprinting to become a valuable tool for human provenance studies.



Supporting 3G

Careful planning was critical to the success of third generation (3G) mobile phone networks. Network infrastructure represented the major part of the capital cost and planning relied heavily on the data used to calibrate the planning tools. An important novel feature of the networks was the use of a new type of variable tilt antenna. The NMS' antenna range delivered better information about how the antennas would behave. This made possible substantial efficiency savings through a variety of mechanisms: fewer base stations needed in rural areas, lower masts and less interference between adjacent base stations in urban areas. Evaluations show that the calibration data improvements could equate to a 1% one-off saving in network capital costs, which equates to a saving of £50 million. Even if the NMS facility were used for nothing else (which is not the case), this calculation gives a benefit/cost ratio (in terms of additional economic surplus) of 25:1.



Global challenges

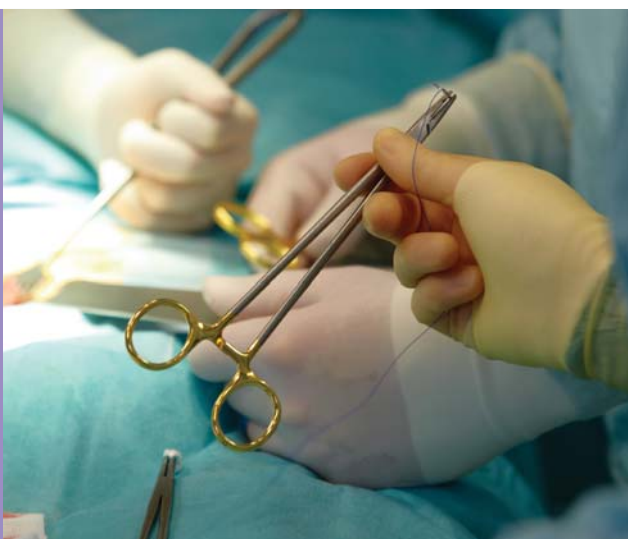
Sizing up the challenge of CCS

Carbon Capture and Storage (CCS) is widely expected to provide a global solution for maintaining fossil fuel energy supplies whilst at the same time minimising carbon emissions. A study by TUV NEL showed that the behaviour of CO₂ and CO₂ mixtures, at the process conditions associated with CCS, introduce distinctive measurement challenges. So the NMS is already raising awareness of the need for standards, working with EU and UK policy makers and regulators, and providing knowledge and capability to address the innovation gap and support the implementation of CCS. This support will help position the UK as European and global leaders in CCS development.



Validating measurements for healthcare

Tacrolimus is an immunosuppressant drug given to patients after an organ transplant and there are strict guidelines as to the amount that should be present in a patient's blood; too much can cause serious liver and kidney complications, whilst too little can cause the organ to be rejected leading to possible patient death. Accurate and traceable methods for measuring Tacrolimus in blood are therefore required. LGC is working with diagnostic kit manufacturers and clinicians to develop reference methods and standards to validate and standardise test methodologies and ensure accurate Tacrolimus measurement. Ensuring optimal dosage and minimising healthcare costs will benefit both patients and healthcare providers.



Confidence in weighing waste

Landfill is the most common disposal method in the UK and each year approximately 100 million tonnes of controlled waste (household, commercial and industrial) are disposed of across 4,000 landfill sites.

Accurate weighing is vital in weighbridges used at landfill sites (as seen in the picture opposite), as the impact that errors can have on the environment, cost to businesses and local authorities are very significant. Local authorities must have robust information on which to base landfill charges, landfill tax and recycling targets. Recycling targets that all local authorities must meet are determined by weight and so, if targets are to be properly measured, we must be confident that the weighing equipment used to determine those targets is accurate. In order to provide this confidence, a programme of inspections helps ensure accuracy of weighing equipment at landfill, recycling and transfer stations throughout the UK.



The NMS

The National Measurement System (NMS) is a network of laboratories and processes that provide measurement standards and calibration testing facilities. It maintains the measurement infrastructure, represents the position of UK measurement internationally and influences the development of standards.

The NMS is funded by BIS (Department for Business, Innovation and Skills), who invest £70 million a year to maintain and improve the measurement infrastructure. It supports innovation in business by demonstrating the compliance of new products and processes, reducing development times, and making existing product improvements possible.

Part of the responsibility of the NMS is to ensure that trade measurements are accurate, legal and fair. Measurement underpins a wide range of public services, including consumer protection, forensic science, environmental controls, safe medical treatment and food safety regulation.

BIS invests £70 million each year to make measurement more accurate for UK business and citizens.

The impact of public investment in measurement is proven: using economic modelling, it is estimated that an additional £6 million spent by Government on measurement technology would deliver up to £410 million of economic impact annually.



How can we help?

NMS invests in facilities and expertise to help UK organisations make better use of measurement.

It is core to the NMS to disseminate knowledge for the benefit of the UK. The right measurements enable innovation, cut waste, increase productivity, reduce new product and process development times, ensure safety and enable quality assurance.

Support is available for organisations of all sizes and includes:

A problem shared – Find out more about the research that we are doing and the problems that are facing your colleagues in other organisations. Join one of the Measurement Networks or subscribe to a newsletter to keep in touch.

Over 13,000 people attend NMS network events each year*

Ask an expert – There are over 500 experts across the NMS laboratories that can provide advice on measurement issues – the NMS supports two hours of free advice – and many issues can be addressed this quickly. The NMS also has a large number of publications, including Good Practice Guides on measurement techniques that you might find useful.

14,500 Good Practice Guides are freely downloaded each year from our websites*

Get stuck into some research – The NMS actively encourages organisations to contribute to our research programmes. You can influence the priorities for our research as we formulate our programme of work or join small teams working on industry focused projects.

64 organisations were involved in joint industry projects*

Got a specific measurement problem? – All of our laboratories undertake commercial consultancy on specialist problems and have a range of standard test, calibration, reference artefacts or training services based on their knowledge gained via the NMS.

Get support from the NMS via the four research laboratories – Each has its own specialist areas – please see the list on the following page.

(*All figures quoted from 2009)



Contact us



The National Measurement Office is an Executive Agency of the Department for Business Innovation and Skills (BIS) with responsibility for the development of the National Measurement System and for the funding of the scientific measurement research programmes delivered by the national measurement institutes. It is also responsible for ensuring that all trade measurements are accurate, legal and fair to buyer and seller.

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National Physical Laboratory

The National Physical Laboratory (NPL) is one of the UK's leading science and research facilities. It is a world-leading centre of excellence in developing and applying the most accurate standards, science and technology available. NPL occupies a unique position as the UK's internationally recognised National Measurement Institute and sits at the intersection between scientific discovery and real world application. It maintains multi-disciplined science facilities and offers a wide range of commercial services that provide industry with the opportunity to utilise our scientific knowledge and expertise to deliver tailored solutions for product development or research programmes.

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**Setting standards
in analytical science**

An international science-based enterprise, operating in socially responsible fields underpinning the health, safety and security of the public. As the UK's designated national measurement institute for chemical and bioanalytical measurement, LGC leads development of the bio-measurement system, focuses on high accuracy measurement research and calibration services, and strengthens the traceability of measurement science that underpins legislation, regulation and standards encompassing healthcare, environmental and food sustainability, and security applications.

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TUV NEL is a leading independent, international technology services organisation. It delivers a range of world-class research, development, modelling, calibration, measurement and testing services to clients across many sectors including energy, environmental, manufacturing and government. TUV NEL is a global centre of excellence and designated national measurement institute for flow measurement.

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