NPL National Physical Laboratory

Engineering *Precisely*

A National Measurement Newsletter

Spring 2007 | Issue 5

Submarine capper blocks feel the mega-force of NPL

The testing of hydrostatic capsules used for nuclear power station tendon testing, proof loading of bridge bearings, and high force calibrations are all common uses for NPL's 30 MN hydraulic force machine.

One recent application has been deflection tests on submarine capper blocks. The blocks allow the submarines to be safely seated when in dry docks for maintenance, repair, and refit, and are made of many wooden pieces bonded together with adhesive. Not knowing if they could take the weight of the submarine more than once meant that maintenance costs had to include the cost of new blocks being manufactured. Linear Variable Differential Transformers (LVDT's) and strain gauges within the machine were used to measure the deflection and applied force when testing the blocks with concrete moulds acting as the submarine.

While the results of this test corresponded with expectations, the unknown characteristics of the adhesive and swelling of the damp wood under reloading, meant that only testing in this manner would give confidence in the reuse of their submarine blocks.

Contents:

For further information on NPL's Force calibration services, please contact Paul Twite or Mannie Panesar on 020 8943 7157/8644 or e-mail paul.twite@npl.co.uk or mannie.panesar@npl.co.uk

NPL lends support

Unsupported calibration beams are widely used in industry because they are a simple and cost effective method of applying torque, and in many instances replicate the way a transducer is used.

The beam and calibration masses are directly applied to the torque transducer under test and a concern is that the weight of the beam and masses introduce bending moments to the transducer and affect the measurement result. For higher precision applications the calibration beam is usually supported by means of a bearing.

NPL has collaborated with Norbar Torque Tools Ltd to investigate the use of unsupported torque calibration beams in industry. During the project, a number of transducers were evaluated on an unsupported beam and their performance compared to their calibration results in NPL's 2 kN·m national torque standard machine.

The project has quantified the effect of using an unsupported calibration beam. While much depends on the design of the transducer used and the specific application, a simple bending test was devised to produce a bending parameter for each calibration that gave good agreement between the two methods.

> “This project has had a significant impact on our work and is of benefit to all users of unsupported beam calibrations, as well as providing added confidence for users of Norbar's calibration beams.”
>
> Barry Pratt - Head of Calibration Laboratory, Norbar Torque Tools Ltd.

The full report is available on request. For further information please contact Andy Robinson on 020 8943 6194 or e-mail andy.robinson@npl.co.uk

NPL's 2 kN·m lever-deadweight torque machine.

Not lost in translation

High precision servo controlled translation stages are used increasingly for nanotechnology applications.

Translation stage calibration facility with interferometers for calibrating the x and y-axes and an autocollimator to measure pitch and yaw in the x-axis.

In the course of their collaboration in the area of scanning probe microscopy, the National Physical Laboratory and the Physikalisch-Technische Bundesanstalt (PTB) in Germany found it was necessary to assess the performance of several high accuracy translation stages and measure deviations from linearity.

To make this possible a facility has been established that uses optical interferometry to calibrate the three axes of a translation stage and autocollimators to measure angular errors. The facility is able to measure displacements within a 1 mm^3 volume.

If you are interested in having translation stages calibrated, please contact Andrew Yacoot on 020 8948 6955 or e-mail andrew.yacoot@npl.co.uk

Vacuum sucks ... or does it?

This is the first in a series of articles highlighting common misconceptions and misunderstandings in the field of Engineering Measurement.

Vacuum science and technology is of fundamental importance in an incredible range of scientific, engineering and manufacturing applications. Despite the often held view that there are no new or challenging problems associated with such a "mature" subject, the reality is quite different.

The variety and strength of international scientific journals devoted to the subject, the enormous annual conferences (with as many as 12 sessions in parallel) and the huge turnover of the associated industries, well over £600 M in the UK alone, demonstrate how much activity there really is.

For a subject of such importance to us all it is perhaps surprising that there are so many misconceptions relating to the basic use of vacuum equipment. One of the most common is the notion of the "sucking" force of a vacuum. This is reinforced by the everyday experience of a 'vacuum' cleaner that appears to 'suck up' dust. In fact, rather than being pulled into the pipe, the dust is pushed along by a force due to the difference in gas pressure between the ground and the inlet to the pipe.

The situation is no different when a vacuum pump is used to evacuate a chamber. At relatively high pressures, where gas flow is dominated by molecule-molecule collisions, the pressure difference between the chamber and the inlet to the pump effectively pushes gas molecules from high to low pressure regions. So in effect the gas is pushed into the pump, not 'sucked' into it.

Performance problem?

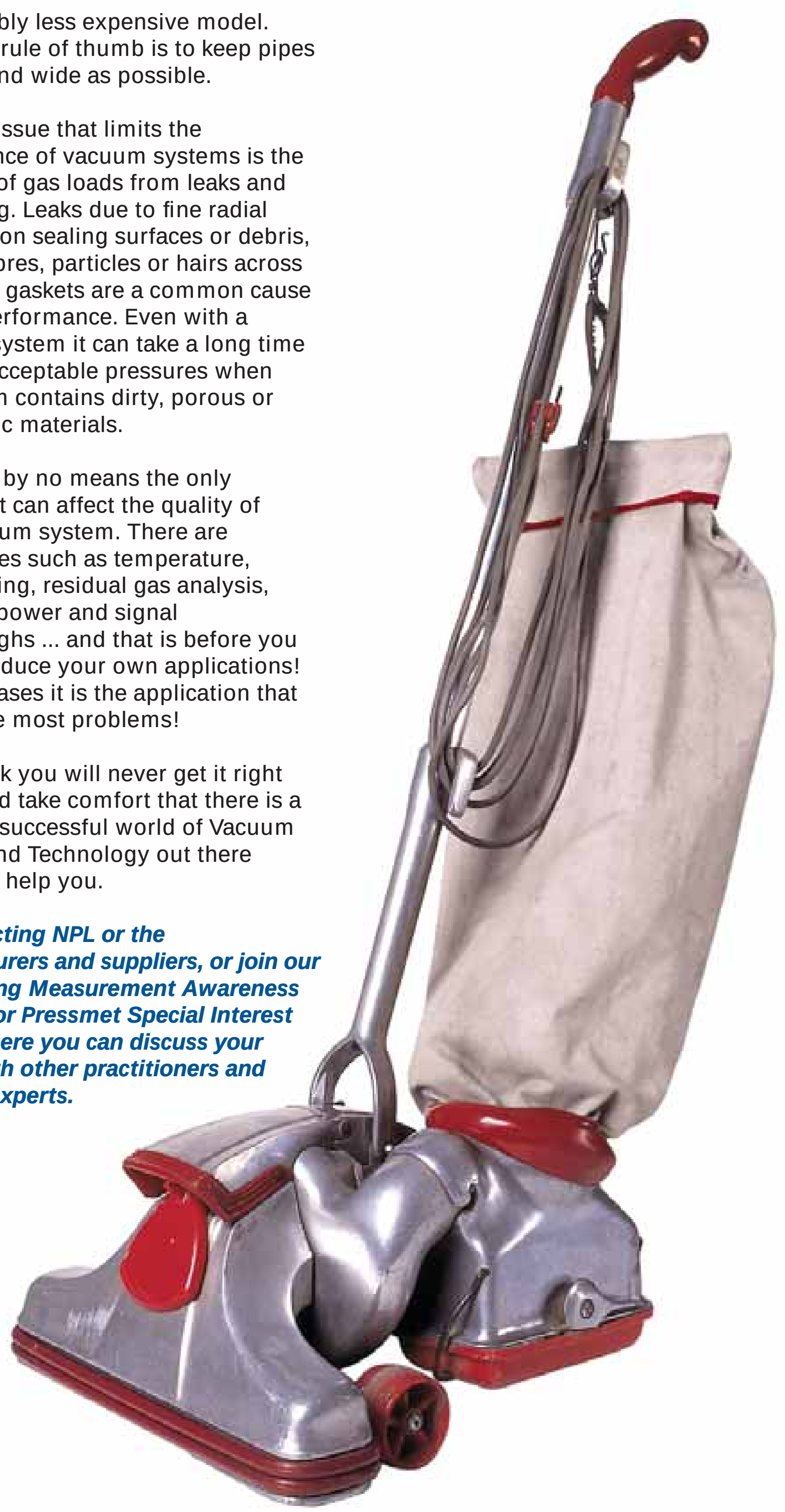
Another common misconception is that a bigger pump will produce a better vacuum. In fact, the "speed" of the pump is only one factor contributing to the rate at which the pressure in the system is reduced. Of equal importance is the "conductance" of the pipework connecting the pump to the chamber. Unfortunately there are many examples of poorly designed systems where a large pump has been connected to the system by a long and narrow pipe, reducing its effectiveness to that of a considerably less expensive model. The basic rule of thumb is to keep pipes as short and wide as possible.

A related issue that limits the performance of vacuum systems is the presence of gas loads from leaks and outgassing. Leaks due to fine radial scratches on sealing surfaces or debris, such as fibres, particles or hairs across elastomer gaskets are a common cause of poor performance. Even with a leaktight system it can take a long time to reach acceptable pressures when the system contains dirty, porous or hydrophilic materials.

These are by no means the only issues that can affect the quality of your vacuum system. There are other issues such as temperature, gas handling, residual gas analysis, cleaning, power and signal feedthroughs ... and that is before you even introduce your own applications! In many cases it is the application that causes the most problems!

If you think you will never get it right you should take comfort that there is a large and successful world of Vacuum Science and Technology out there waiting to help you.

Try contacting NPL or the manufacturers and suppliers, or join our Engineering Measurement Awareness Network or Pressmet Special Interest Group where you can discuss your issues with other practitioners and industry experts.



The beams of science fall

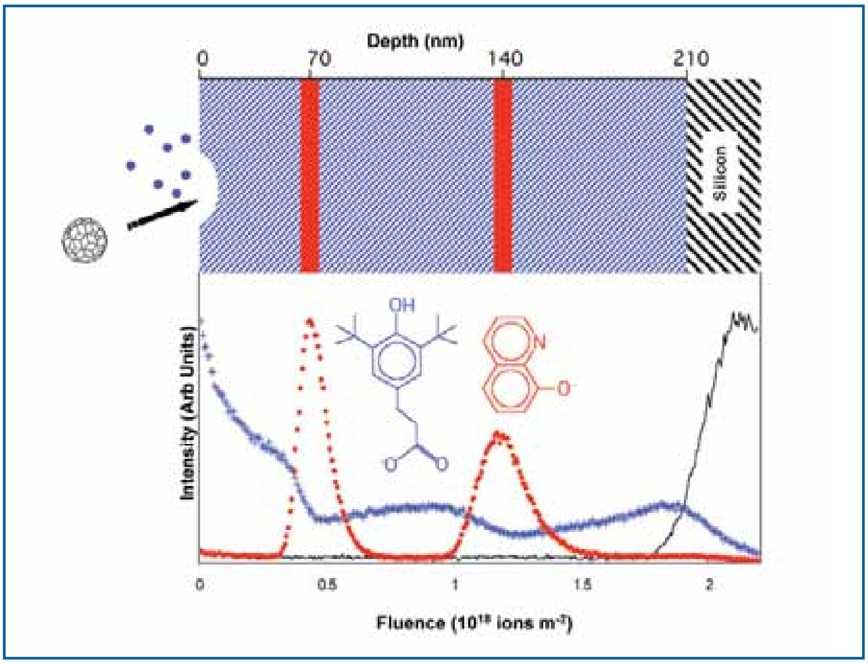
Through a Measurement for Emerging Technologies (MET) project, NPL is exploring the use of a beam of Bucky Balls (Buckminsterfullerene) to determine the unique molecular composition of multi-layer organic materials on the nanoscale.

Knowledge of the layer structure of organic coatings is key in some of the UK's leading emerging technologies, including organic electronics and drug delivery systems. For example, in the healthcare sector there is rapid growth in the use of medical devices coated with polymeric films to improve biocompatibility and act as a reservoir for the controlled release of therapeutic agents. The cardiovascular stent market is worth >$5 billion and drug-eluting stents are a key growth area, The UK is a major player in the development of organic and polymer electronic devices, and the global market in organic light emitting diodes alone will be worth $4 billion by 2009. All of these industries require a precise organic architecture, the thickness and composition of each layer being critical to the correct and reliable functioning of the product. Issues such as contiguity, diffusion and intermixing must be avoided, but currently there are few analytical techniques that offer a means to measure these phenomena. Within this MET programme, NPL is developing an organic depth-profiling capability analogous to the depth profiling carried out in the traditional, silicon-based semiconductor industry. Other key measurement aspects of the project include the development of methods for measuring charge mobility and conductivity in thin organic films and the optical characterisation of emissive and reflective displays.

Inorganic materials are traditionally depth-profiled by sputtering layers of the material and chemically analysing the freshly exposed surface. Sputtering is performed by striking the surface with energetic atomic ions. As well as removing layers of material, the ions can damage the remaining material. For inorganic substances this damage is not often a problem because the elemental composition, which constitutes the important analytical information, is not substantially changed by damage. However, for organic materials the elemental composition is less important than the detailed bonding arrangements between atoms, which can be termed the 'molecular composition'. It becomes impossible to uniquely identify organic constituents in a depth profile without knowing the molecular composition. Very recently it has been reported that depth profiling of organic materials is possible using cluster ions, rather than atomic ions. Within this project, we are exploring the utility of buckminsterfullerene (C60) ions in this regard. Because of its shape, this molecule is an ideal impact initiator.

To be of use in the characterisation of industrially relevant materials, the depth profiling technique should be able to profile materials that are up to a micrometer thick with a depth resolution of better than 10 nanometres. Currently, there are significant unknowns that urgently require attention. These include establishing the utility of the technique for a wide range of organic systems, measuring the sputter rate of different materials and determining the depth resolution. NPL is now establishing the basic metrological parameters that are required to utilise this approach to organic profiling. We have already demonstrated how sputter rates can be modelled for a few, selected materials and have shown that the unique molecular composition of an organic layer can be determined in depth profiles through layered materials. We have developed novel molecular delta layers which allow the depth resolution and response function of the technique to be determined. This has shown that a depth resolution of better than 10 nanometres is certainly achievable. Our work in this area will allow analysts to select the most appropriate conditions for their depth profiling requirements and to reliably apply a depth scale to their data.

Through this work, NPL has developed its understanding and techniques – now it must apply this knowledge to solving



A C_{60} depth profile of a molecular multilayer of Irganox1010 (blue) and aluminium hydroxyquinolate (red). The molecular composition of the blue and red zones is given by the respectively coloured structures in the lower part of the figure.

real issues in materials and devices of interest to industry. The partners (Cambridge Display Technologies, Novalia, Kodak, ICI, NTERA, University of Nottingham and Imperial College) in the MET project represent the key companies in the UK market. They are supplying us with samples that include organic thin film transistors, polymer light emitting diodes and drug delivery devices. In the future, these measurements will be correlated with device performance, which will be established through the other two strands of this MET project. This new analytical method is applicable to a wide range of technologies including ink-jet printing, nano and microscale surface functionalisation, packaging and organic thin films.

For further information or how to participate in this project please contact the MET enquiry point, met@npl.co.uk or visit the website: www.metprog.org.uk

Heat transfer in polymer processing - a cooling off period

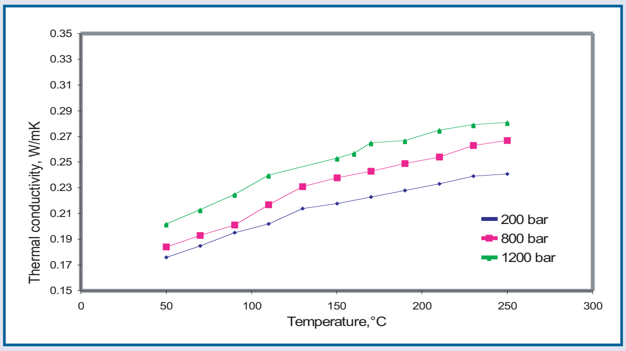
The cooling phase during polymer processing is extremely important to maximise the efficiency of the plant, whilst minimising problems such as frozen-in stresses and warpage.

Process simulation is an important tool for design, but reliable solutions require accurate data obtained under conditions typical of processing. Measurements by NPL using the transient probe method clearly showed that the thermal conductivity of a polystyrene was some 65% higher at processing temperatures and pressures than it was at near-ambient conditions.

Transient methods for thermal conductivity or diffusivity are particularly suited to testing plastics. Transient testing can be quick and thus degradation, a problem particularly for plastics in their molten state, can be avoided. Also, thermal conductivity is known to be affected by the microstructure of the plastics, i.e. its crystallinity and orientation, and these factors are affected by the processing history and specimen geometry. Thus an ability to measure the properties of the moulded product is desirable for accurate prediction of the performance of that product. However, the accuracy and precision of transient methods is uncertain.

International standards for laser flash, planar heat source and temperature wave analysis methods for thermal conductivity of plastics are being developed (ISO 22007: Plastics - Determination of thermal conductivity and diffusivity). In support of this activity, and in order to provide an understanding of the quality of data obtainable from transient techniques, NPL, in collaboration with the Tokyo Institute of Technology, are organising an intercomparison of transient methods for thermal conductivity of plastics.

For further information, or if you are interested in participating in the intercomparison please contact Martin Rides on 020 8943 6777 or e-mail martin.rides@npl.co.uk



Thermal conductivity of polystyrene (AAATK002) on cooling from 250 °C to 50 °C at pressures of 200, 800 and 1200 bar.

Melt flow rate testing of moisture sensitive plastics – a problem being solved

Measuring the flow behaviour of some commonly used plastics is not possible using standard melt flow rate testing, leading to expensive and often hazardous alternatives. As part of an international collaboration NPL is striving to overcome the hurdles.

Melt flow rate testing (ISO 1133) is widely used in the plastics industry to measure flow behaviour, but not for all commercially important plastics. It is not suited to testing moisture sensitive plastics including polyethylene terephthalate (PET -widely used for soft drinks bottles and foods packaging), polybutylene terephthalate (PBT) and nylons. These plastics will degrade at the test temperature due to absorbed water. The alternative method, using solvents to measure intrinsic viscosity, is expensive and possesses environmental and health and safety problems.

NPL, in collaboration with organisations from the Netherlands and Japan, are addressing this problem by developing the melt flow rate method to improve its accuracy and precision for such difficult materials. This method will be published as Part 2 to ISO 1133. In support of these standardisation activities, NPL will be leading an international intercomparison to validate the improved method – you are welcome to participate in it.

This work builds on previous developments in the melt flow rate method at NPL. Melt flow rate (MFR/MVR) testing predominantly characterises the shear flow behaviour of polymers. As the bulk of polymers are converted in processes in which the flow is predominantly extensional (bottle blowing, film extrusion, vacuum forming) it is considered more appropriate to characterise the materials using an extensional flow technique. This has been achieved by NPL using only minor modification to the method, using a short length die, and has been shown to provide better understanding of the processability of materials in extensional flows. This new development is thus considered to provide improved QC procedures.

For further information or if you would like to participate in the intercomparison please contact Martin Rides on 020 8943 6777 or e-mail martin.rides@npl.co.uk

Does it feel good?

Wood, leather and stone finishes, either natural or synthetic, are found in abundance in the products we purchase, for use in the home, car, leisure and retail outlets or office.

The quality of nominally similar products can vary considerably, and the human perception of products is critical to their commercial success; products that look and feel good will be more likely to succeed in the competitive marketplace. Improved design that considers the human interaction with products at a sensory level will enhance that perceived quality.

NPL is leading a European collaborative project on the measurement of naturalness, investigating why products are perceived as being of good or poor quality by trying to understand the interactions between human and product. As part of this project NPL will be developing its extensive mechanical and optical measurement capabilities, including novel instrumentation for measuring the friction coefficient between skin (the operator's finger) and the material.

If you are concerned about the perceived quality of your products, and how to specify them in an appropriate manner, then you should be interested in this project.

For further information please contact Martin Rides on 020 8943 6777 or e-mail martin.rides@npl.co.uk

Sensing the benefits of a secondment

GE Sensing is a world leading UK based manufacturer of MEMS pressure sensors. To learn more about the world of MEMS, NPL scientist Simon Reilly joined them for a week as part of a secondment scheme.

Microelectromechanical systems (MEMS) sensors are a rapidly expanding technology worth around $12 billion worldwide in 2004 and the market is predicted to be worth $25 billion by 2009. The industry has been expanding at such a rate that the underpinning metrology is struggling to keep pace.

During the secondment Dr Reilly learned a great deal about the working practices of a successful MEMS manufacturer, how metrology plays a vital part in the fabrication process, and how NPL research can help keep the industry moving forward.

As a result GE Sensing are now partnering NPL and Taylor Hobson in a joint industry project to address the problem of accurate wafer thickness measurement – vital to advancing several types of MEMS sensor including gyroscopes and pressure sensors. NPL is also formulating work with GE Sensing on reducing calibration times to improve production time. In addition, the secondment allowed NPL to assist GE Sensing to investigate both diaphragm bow which affects device linearity and varying etch rates across a wafer facilitating a higher yield rate.

> “GE Sensing greatly recognize the benefit of collaborative working with NPL on short industrial exposure visits. During this time we were able to demonstrate a number of the MEMS measurement challenges that are specific to our business. The two-way information exchange clearly benefited NPL as well as GE Sensing. In the long term we see this form of industrial feedback as being essential to ensure NPL are focusing efforts in a way that best targets the needs of UK PLC.”
>
> Dr Nic Moisoi of GE Sensing

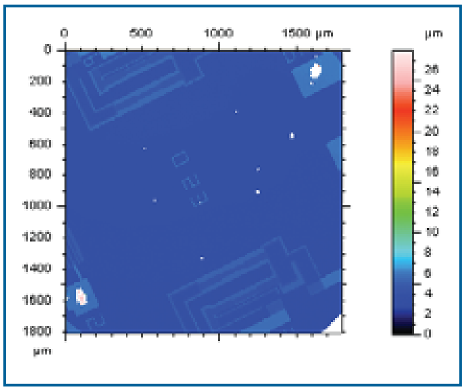


Image of MEMS pressure sensor diaphragm taken using white light interferometry.

For further information on MEMS technology and metrology please contact Simon Reilly on 020 8943 7101 or e-mail simon.reilly@npl.co.uk

New NPL report highlights metrology needs of MEMS manufacturers

To help metrology keep pace with the expanding limits of MEMS technology NPL has compiled a report detailing the MEMS sensor industry’s metrology needs and likely future requirements.

The report, entitled *‘Overview of MEMS sensors and the metrology requirements for their manufacture’*, gauges the metrological requirements of the MEMS sensor industry, reviews current MEMS manufacturing and metrology techniques, and highlights how metrology plays a role when manufacturing some of the key types of MEMS sensor (pressure; RF and microfluidic sensors; accelerometers and gyroscopes). The report details current metrology techniques used in MEMS manufacture such as profilometry, micro co-ordinate measuring machines, electron microscopy, optical microscopy, white light interferometry and laser Doppler velocimetry, and discusses their inherent limitations.

Companies that contributed to the report included BAE Systems, Epigem, ETB, GE Sensing, Memsstar, QinetiQ, Rutherford Appleton Laboratory, STS and Tecan. Areas highlighted for future research include the measurement of

- high aspect ratio microstructures
- sidewall parallelism
- wafer thickness
- hermeticity
- development of a traceable infrastructure for vibrometry.

NPL is now embarking on research and development projects that address the metrology areas highlighted by the report. The report has led to secondments, joint industry projects and a new direction for the current National Measurement System Engineering Programme.

For further information and copy of the report (NPL Report DEPC-EM-008) please contact Richard Leach on 020 8943 6303 or e-mail richard.leach@npl.co.uk

NPL Materials Industrial Advisory Groups (IAGs)

Communication between NPL and UK industry is vital to ensure the industrial relevance of NPL research programmes. A key mechanism for developing and maintaining this relationship is the Industrial Advisory Group.

An Industrial Advisory Group (IAG) is an independent body of cross-sector experts coordinated by NPL. The purpose of an IAG is to facilitate a focused discussion on particular themes of materials metrology, structured around the government funded NMS projects run by NPL.

Group members get specific benefits including the ability to:

- Guide and monitor progress of DTI funded research programmes
- Ensure NPL projects are industrially relevant
- Advise on the business application of knowledge
- Provide input to future projects and influence NPL strategy
- Networking opportunities (of especial benefit to SMEs)
- Access to sample testing via in kind contribution of materials
- Access to project outputs (reports, measurement notes)

The following table lists the current IAG meetings within the Industry and Innovation Division.

Typical Format:

- **One day meeting**
- **Six monthly intervals**
- **Multiple sector**
- **Lively and open discussion forum**
- **Opportunity to visit facilities**

If you would be interested in attending a meeting or obtaining more information on any of the IAGs, please contact the relevant coordinator listed using the e-mail format 'firstname.lastname@npl.co.uk'

Title	NPL Contact	Date of next meeting
Bio-materials and tissue engineering	Paul Tomlins	27/03/07
Polymeric Materials: Characterisation and processing properties	Martin Rides	18/04/07
Polymer Performance	Bruce Duncan	27/03/07
Polymers: Multi-scale Properties	Bill Broughton	17/05/07
Polymer Composites	Michael Gower	01/05/07
Stress corrosion cracking of stainless steel	Alan Turnbull	May 07
Stress corrosion cracking of steam turbine steels	Alan Turnbull	17/04/07
Fuel cells	Gareth Hinds	14/06/07
Miniature Tests	Bryan Roebuck	28/03/07
Electronics in Harsh Environments	Chris Hunt	TBC
Surface Technology	Mark Gee	TBC
High Temperature Degradation	Tony Fry	15/03/07
Materials Chemistry and Thermodynamics	Hugh Davies	TBC
Residual Stress & Distortion	Jerry Lord	TBC
Cleanliness Evaluation for advanced applications	Rob Brooks	TBC
Solder Interconnect Properties	Chris Hunt	08/03/07
Polymer Coatings in Electronics	Chris Hunt	13/03/07
Functional materials	Markys Cain	18/07/07
Ionic Liquids	Alan Dinsdale	Mar 07
Mapping Microstructures in Dynamic Tests, Metal Working	Bryan Roebuck	27/06/07
Hard Materials	Ken Mingard	22/03/07
Powder Sizing	Ken Mingard	May 07
Powder Compaction - Cracking in green compacts	Ken Mingard	May 07

Investing in Bilbao

Scientists from NPL attended the European Investment Casting Federation 50 year anniversary conference in Bilbao, Spain, last May. The conference brought together over 200 engineers, scientists and specialists from academia and 100 casting related companies, delivering a programme of 31 papers and 30 trade stands.

The Investment Casting Industry, in which the UK is a leading player, supplies leading edge manufacturing companies with critical components in the aerospace, automotive, power generation, medical, food, construction and other sectors, and is projecting increased turnover for the foreseeable future. NPL presented work on the dimensional stability of commercial shell systems, a collaborative project with the University of Birmingham and 5 industrial partners providing understanding and data of the deformation of ceramic shells under casting conditions.

An exhibition stand also provided information about the measurement of physical property data required for process modelling, the estimation of properties using NPL's Virtual Measurement System, and best practice for the measurement of temperature.

To find out more about the services NPL can offer in this field please contact Rob Brooks on 020 8943 6496 or e-mail rob.brooks@npl.co.uk

Building a better future

Under the Kyoto agreement, the UK agreed to cut its CO_2 emissions by 12.5% of 1990 levels by 2012. In order to reach this target we must cut our energy consumption and become more energy efficient. NPL is working toward this goal by helping the UK building industry comply with new standards.

There is often a perception that transportation and industrial processes are the largest producers of CO_2. However it is now estimated that about 40% of energy consumption in the UK is spent in space heating and cooling of buildings. Following the EC's Energy Performance of Buildings Directive (2003), the UK government introduced new amendments to part L of the UK Building Regulations earlier this year.

Under the new regulations, energy efficiency standards for both new build and renovated buildings will have to be dramatically improved. To achieve this goal all building materials and components such as roof and cavity wall insulation, double-glazed windows and doors will have to meet new thermal performance standards.

The NPL Thermophysical Properties group have been carrying out thermal performance measurements on building materials since 1978. NPL is one of the few organisations in the UK accredited to carry out many of the tests according to the EU measurement methods and works with industry regulators to support the implementation of the new regulations.

NPL have recently set up a measurement facility to enable the U-values of industrial doors to be measured to a new EU Product Standard and have also worked with window manufacturers and their trade associations to quantify the improvement in thermal properties achieved by changing the spacing bar design in double-glazed window units.

Photo Courtesy: LRT Surveys Limited

Thermal map of St. Paul's Cathedral.

At present, NPL is actively involved in working groups preparing CEN and ISO standards for measuring the thermal transmission through building components. These measurements allow suppliers to certify their products and builders to build more energy efficient factories, offices and homes according to the new building regulations. This should lead to a reduction in energy that will benefit businesses, homeowners and the environment.

NPL Thermal Performance Facilities

- A validated hot box, capable of measuring the U value of structures up to 300 mm thick (e.g. curtain walls & roof panels), at all orientations, with a target uncertainty of ± 6%.
- A range of national standard Guarded Hot-Plate facilities for measuring the thermal conductivity or thermal resistance of a wide range of building materials and insulation products for EN 12664:2001, EN 12667:2001 and EN 12939:2000.

The Thermal Metrology Programme and research at NPL is underpinned by the DTI's National Measurement System (NMS).

For further information on NPL's Thermal Programme and research contact Ray Williams on 020 8943 6510 or e-mail ray.williams@npl.co.uk

Microwave radiometry - keeping a cool head

Internal temperature measurements are necessary in a wide range of fields, including medical situations where they can have an impact on the quality of therapy, and in the food industry where the safety of food is at stake.

For many of these applications contact thermometers are impractical, so there is a need for an inexpensive, non-contact method of measuring internal temperature which is both reliable and accurate. Microwave radiometry offers a potential solution and commercial instruments for food applications are already available.

Microwave radiometry measures the temperature dependent intensity of natural Planckian thermal radiation emitted by a material over a band of frequencies in the microwave region. From 1 GHz to 4 GHz, human tissue is partially transparent to electromagnetic radiation, allowing the radiometer to measure temperature within the material to a depth of several centimetres.

One possible application could prevent thousands of babies from suffering brain damage. The risks of permanent damage to the brains of premature babies with oxygen deprivation can be drastically reduced if the brain is cooled for a period of 24 to 48 hours immediately after birth.

Knowledge of the tissue temperature during a thermal therapeutic procedure gives the clinician instant feedback so that close control of the level of heating or cooling can be maintained. It is vital that the temperature is kept within tight limits to achieve effective therapy and minimise permanent damage to tissue. Using microwave radiometry to monitor the temperature of brain tissue could benefit 1000 babies per year in the UK.

NPL is working in partnership with Glasgow University, Imperial College and Hammersmith Hospital to test and validate microwave radiometry using phantom tissue targets that closely mimic the tissue properties (e.g. dielectric properties) and the temperature gradients created during the thermal therapy.

At NPL the performances of two radiometers of different design developed at Hammersmith Hospital and Glasgow University have been measured and compared by making measurements with (1) an isothermal target and (2) a linear temperature gradient phantom target. From these measurements, an assessment has been made of basic noise performance and the ability to measure sub-surface temperature of the two microwave radiometers.

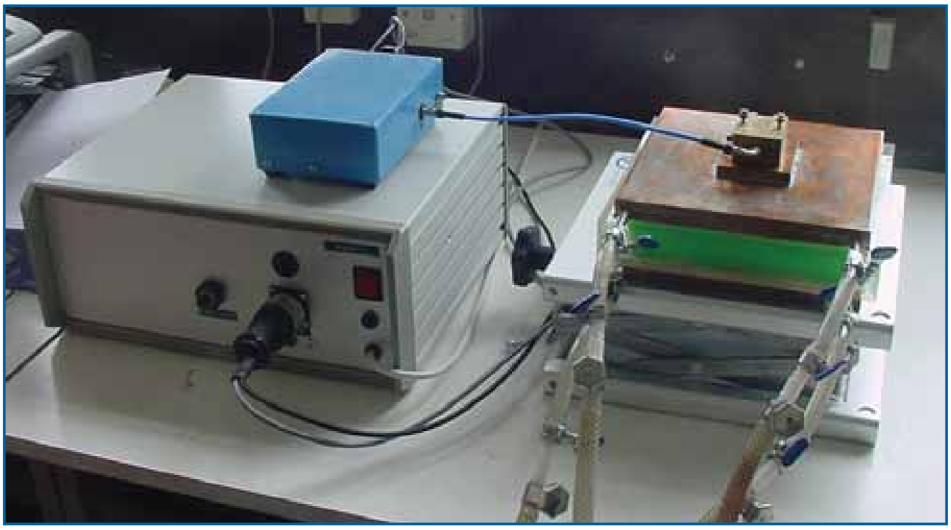
The isothermal target measurements were performed with the radiometer antenna coupled to a temperature-controlled water bath. A time-series of radiance temperatures were measured, and an Allan deviation plot computed from which the drift and noise characteristics of the radiometer could be quantified.

The linear temperature gradient target measurements were performed with an antenna coupled to a 3 cm thick sample of "phantom tissue" with similar dielectric properties to infant grey matter tissue. The target simulates the superficial layers of a baby's brain in which the upper face of the sample represents the skin surface and the lower surface corresponds to the brain core.

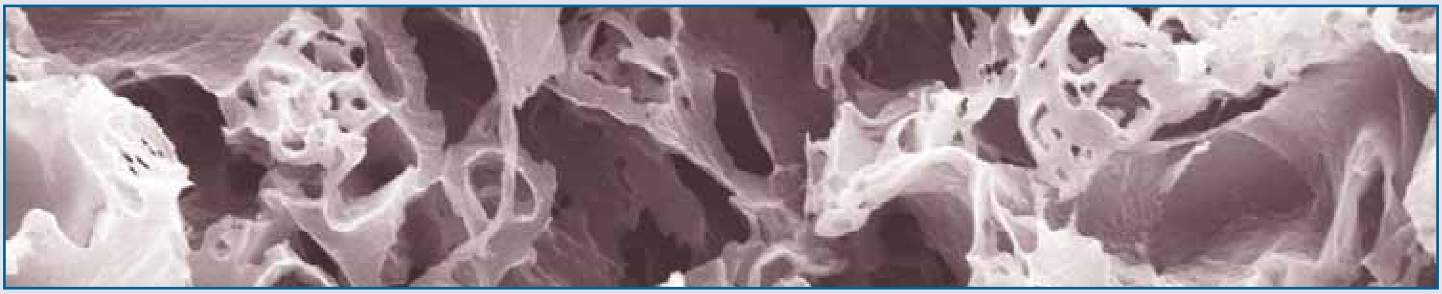
The radiometer developed at Hammersmith Hospital is a single reference null-balance design which has lower noise figures and a longer response time. The radiometer developed at Glasgow University is a two-reference switch sequence design with a slightly higher noise figure and a shorter response time.

This work has shown that the two different designs have different strengths and weaknesses but within limits they give reasonable measurement of internal temperature under laboratory conditions enabling more confidence in their use.

For further information please contact Andrew Levick on 020 8943 6301 or e-mail andrew.levick@npl.co.uk



A linear temperature gradient phantom target developed at NPL together with the microwave radiometer developed at Glasgow University



Developing standards for tissue engineering

NPL is working with other international measurement institutions to develop and conduct comparative studies to support the tissue engineering field.

Even from a cursory glance through the tissue engineering literature, it is apparent that there are currently no common procedures in place for assessing, for example, the viability of cells growing in a tissue scaffold or the consistency of some of the scaffolding materials such as alginates and collagens. This poses a fundamental issue for researchers, regulators and for commercialisation: how can you be sure that what you are doing is reproducible? The answer to this question may, at least in part, lie in the development of standards.

Standards documents outline globally accepted methods for evaluating materials, assessing structures, monitoring tissue development and appraising the ‘quality’ of the final product. In principle this is a straightforward task, but unfortunately, this is not true for tissue engineered medical products. Many of the existing standards and those that are being developed take the form of Guides and come from ASTM International, an international voluntary standards development organisation. An ASTM Guide is an informative document that describes several solutions to solving a measurement problem, discussing the pros and cons of each. Guides are produced when there is no simple solution to solving a measurement problem. Translation of these Guides into ‘traditional’ standards will take time and require a number of international round-robins to identify the ‘best’ procedures.

A newly formed international committee operating under the VAMAS envelope has taken on the task of organising these round robins. The committee has strong links with standards bodies including ISO, DIN and ASTM and consists of representatives from national standards laboratories, academics and industry. The committee, which includes NPL, has identified three initial project areas:

- The interpretation of tissue scaffold images
- Measurement of cell adhesion in a laminar flow cell
- Assessment of a hydroxyapatite/ collagen matrix

Details of the round robin are currently being developed and a call for participants will be issued shortly.

If you would like further details about the committee, its goals or would like to be involved in the round robins then please contact Paul Tomlins on 020 8943 6778 or e-mail paul.tomlins@npl.co.uk or visit www.astm.org and www.vamas.org

Entries invited for Young Persons’ Award for Innovation in Acoustical Engineering

The UK Institute of Acoustics is inviting nominations for the second round of its ‘Young Persons’ Award for Innovation in Acoustical Engineering’.

Institute of Acoustics

Judges will be looking for entries that are: innovative and inventive; feasible and practicable; money-saving; green; end-user friendly; time-saving and that are improvements to existing processes.

Colin English, President of the Institute of Acoustics, commented, “A career in acoustics gives great opportunities for making a difference to people’s lives especially in this increasingly noisy world. Acoustics undergraduate courses tend to attract a high calibre of student who, once they enter industry, are often full of ideas for innovation. We anticipate a high standard of entries again this time.”

Entries are welcomed from now until the closing date of 30 March 2007 when the distinguished panel of judges drawn from academia and industry will select a winner and two runners up.

More information and entry forms can be downloaded from the IOA website at http://www.ioa.org.uk/ medals.asp or from the dedicated Award page on IAC’s website at www.industrialacoustics.com/uk To receive an entry form by post contact tel: 0172 7848195 fax: 850553 e-mail ioa@ioa.org.uk

If you would like further information on any aspect of
NPL Engineering Precisely, please contact:
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Temperature and humidity – measurement and calibration courses

23 to 27 April 2007, NPL, Teddington

Once again NPL is running its popular training courses on temperature and humidity measurement and calibration. Suitable for technicians and technical managers closely concerned with temperature and/or humidity measurement and calibration, the companion courses concentrate on those methods of measurement which are of greatest technological and industrial importance.

The Temperature course (23 to 25 April) will cover temperature scales and standards, including a résumé of the International Temperature Scale of 1990, ITS-90, and the three most important measurement techniques. The five laboratory sessions will be concerned with fixed points, resistance thermometers, thermocouples, radiation thermometers and liquid-in-glass thermometers. These will be supplemented by lectures in calibration techniques, uncertainties, traceability and accreditation. The **optional third day** will provide opportunities for more in-depth training and ‘hands-on’ experience of some of the calibration techniques regularly used at NPL.

The Humidity Course (26 to 27 April) will cover measurement techniques and instrumentation, practical use of instruments, calibration, examples of good practice and calculations/conversion between different units. A tour of the NPL Humidity Laboratory, plus “hands-on” sessions, will give a practical introduction to humidity measurement and calibration techniques.

For further information including registration forms and prices please visit www.npl.co.uk/thermal

Forthcoming events

21 March 2007, Institute of Physics, London
Autonomous Systems Workshop
www.qi3.co.uk/events/event.asp?EventID=150

26 to 27 March 2007, NPL, Teddington
International Workshop on Monte Carlo codes
www.npl.co.uk/ionrad/training/montecarlo/
E-mail: gill.coggins@npl.co.uk

28 to 29 March 2007, NPL, Teddington
13th UK Monte Carlo User Group Meeting (MCNEG 2007)
www.npl.co.uk/ionrad/training/montecarlo/
E-mail: gill.coggins@npl.co.uk

23 to 25 April 2007, NPL, Teddington
Temperature Measurement and Calibration
www.npl.co.uk/thermal
E-mail: thermal.enquiry@npl.co.uk

25 April 2007, Institute of Materials, Minerals & Mining, London
Corrosion in Power Plants
www.iom3.org
E-mail: paul.mcintyre@iom3.org

26 to 27 April 2007, NPL, Teddington
Humidity Measurement and Calibration
www.npl.co.uk/thermal
E-mail: thermal.enquiry@npl.co.uk

2 to 3 May 2007, Cardiff International Arena
Clinical Temperature Measurement & Thermography
www.npl.co.uk/tman/meetings/2-3_may_07/callforpapers.pdf
E-mail: j.a.pickett@qmul.ac.uk

17 May 2007, Old Trafford Stadium, Manchester
UK Trade & Investment - International Energy: Meet the Buyers
www.qi3.co.uk/events/event.asp?EventID=155

18 to 21 June 2007, Lille, France
13th International Metrology Congress
www.cfmetrologie.com/congres_en.php