Vol 31 No 3 MAY/JUNE 2006

ACOUSTICS BULLETIN

in this issue... Spring Conference 2006

plus... Reducing Impact Sound

Aircraft Noise: Annoyance, House Prices and Valuation

Audio Power Amplifiers: A Brief History

Control of Noise at Work Regulations 2005

Institute of Acoustics

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Vol 31 No 3 May/June 2006

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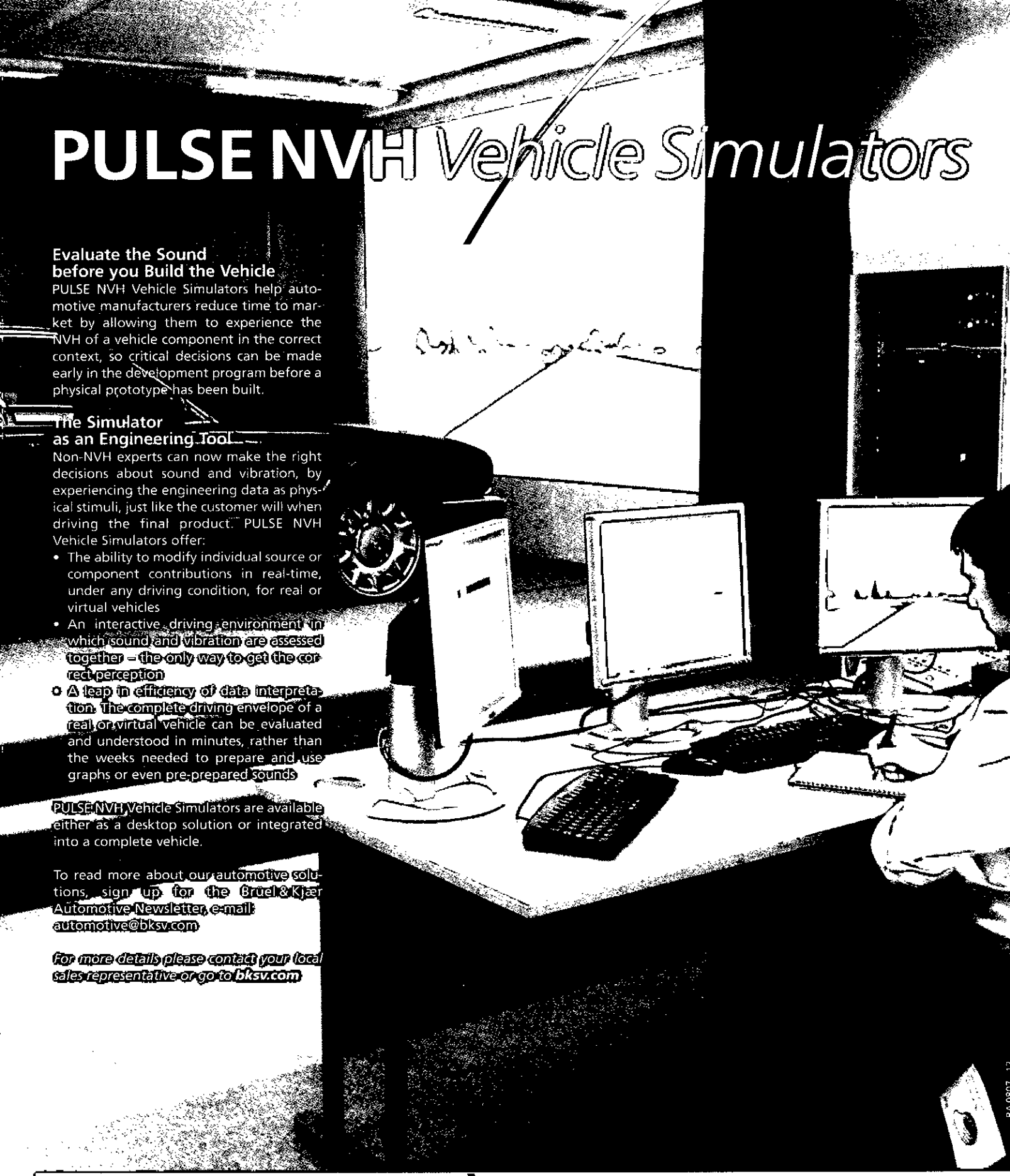

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Brüel & Kjær

Dear Members

The pressures of publishing deadlines mean that I am in the curious position of writing my first President's letter while still President Elect; however, I am keenly aware that I have the good fortune of taking office at a time when the health of the Institute has never been better. It is also a time of significant change, perhaps the most notable being the retirement of our Chief Executive, Roy Bratby. For the last nine years he has quietly transformed the head office machinery into a truly professional organisation. His genial smile, wisdom and good humour will be greatly missed at Council meetings and I am sure that I speak for the whole membership when I wish him an very happy and well earned retirement. His successor, Kevin Macan-Lind, has been working alongside Roy to ensure a smooth transition and I'm looking forward to working with Kevin and seeing his different business skills develop the Institute still further.

Council has been working for some years now on the strategic development of our Institute and the changes that we have already implemented have started to bear fruit. Membership stands at over 2600 for the first time and, more significantly, the number of new members joining last year was higher than for many years. The recent members' questionnaire was just one of the initiatives designed to make the Institute's services as relevant as possible to members. Head office is busy analysing the responses and the many good ideas contained in them. One encouraging result was the large number of people expressing an interest in getting more involved with the running of the Institute. We always need more committee members and I urge those of you who ticked the box to come forward and get involved. I think that everyone who serves on our committees finds it very rewarding.

The Spring Conference was an undoubted success and with over 200 delegates it was our best attended conference for many years. It was particularly encouraging to see so many young people both attending and giving papers. May I record my thanks to Professor Tim Leighton and the rest of the organising committee for ensuring that the conference ran so smoothly.

I am delighted that John Hinton is joining Council as President Elect. He will be well known to members, both for his work for the Institute and also his pioneering work on noise mapping. Finally, each election sees inevitable retirements and Geoff Kerry steps down after 20 years on Council, including terms as Treasurer and President. Few have served the Institute for so long and I thank him, on behalf of the whole membership, for the tremendous contribution he has made over the years..

Colin English

PRESIDENT ELECT

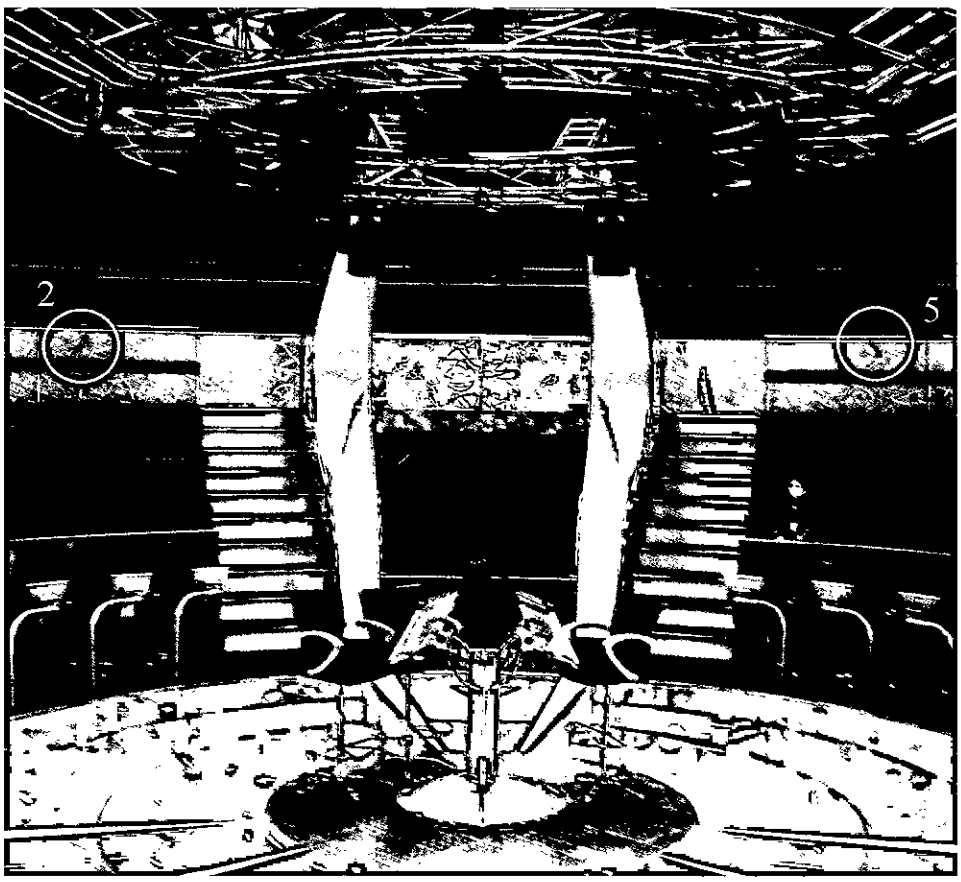
Meeting Report: Eastern Branch

Michael Alston MIOA. **The Acoustics of a Fraud: Who Wants to be a Millionaire?**

On 23 November 2005 members of the Eastern Branch were able to benefit from a lecture by Philip Harrison of J P French Associates, York, 'The Acoustics of a Fraud: Who Wants to be a Millionaire?'.

In 2001 Major Charles Ingram won the £1 million top prize on the television game show Who Wants to be a Millionaire?. The unusual way in which he answered the questions and the regular occurrence of coughing within the studio during the recording raised the suspicions of the production staff and gave them cause to suppose that he may have cheated. The prize money was withheld and the police were contacted. The police investigation concluded that the Major had been prompted by a series of coughs from within the studio. The firm of J P French Associates, because of its specialist knowledge on forensic acoustics, was instructed to carry out an analysis of the audio recordings of the episode, in an attempt to determine from where in the studio the coughing had originated.

Philip's presentation discussed the work undertaken to locate the cougher, and also covered several other aspects of the recordings which were analysed during the course of the investigation. Video clips from the episode and photographs from the studio were used to illustrate his fascinating and instructive talk.



Institute Of Acoustics Appoints New Chief Executive

Kevin Macan-Lind

The Institute of Acoustics has appointed Kevin Macan-Lind as its new Chief Executive. He will succeed Roy Bratby who has decided to take a well-earned retirement after nine years of dedicated service to the IOA.

Kevin started his professional life in banking working for the Australia and New Zealand Banking Group and Barclays Bank. He has many years' experience of business administration which included the running of his own successful publishing and event management business for fifteen years. Two years ago the business magazine publishing and exhibition arm of his business was sold and he was appointed Managing Director of an established health products mail order company, based in Hertfordshire.

"I am delighted to have joined the Institute of Acoustics at this time" he commented. "The IOA has been providing a superb service to its membership for over thirty years, and I have been particularly impressed with its professionalism and the quality of its education, training, and meetings programmes. I look forward to playing a full part in the future developments of the organisation and meeting as many members as possible in the coming months."

Welcoming Kevin on his appointment, Dr Tony Jones, President of the Institute, said "We are delighted to have Kevin on board as our new Chief Executive. I have high expectations that his entrepreneurial experience, knowledge and enthusiasm will ideally suit him to the task of building on the substantial progress already achieved by the Institute. On behalf of everybody involved with the Institute of Acoustics, I would also take this opportunity to pay tribute to the outstanding level of commitment demonstrated by Roy Bratby as our Chief Executive over the last nine years. Roy's diligence and professionalism have been instrumental in the success of the Institute during this period of development, and he can be justly proud of his achievements. I wish Roy every happiness in his well deserved retirement."


Kevin Macan-Lind

Meeting Report: Midlands Branch

Kevin Howell MIOA. **Pyramids, Mud and Music**

The Midlands Branch got the 2006 meetings programme off to a fine start on 22 February at the WS Atkins offices in Birmingham, when David Leversedge of Capita Symonds gave an information-packed presentation on 'Pyramids, Mud and Music: Sound Control at the Glastonbury Festival'. The meeting was attended by 27 (23 of them members).

David began with a brief history of music festivals from the Reading Jazz and Blues Festivals of the late 1950s through the Isle of Wight and Hyde Park events of the late 1960s. It was at the Bath Festival in May 1970 that farmer Michael Eavis had the idea of organising his own festival. Later that year, at Worthy Farm, the Glastonbury Festival was born. Entrance was £1, including free milk from the farm, and the event attracted an audience of 1500.

In the early years the local authority involvement on noise was limited to some monitoring carried out with a hand-held sound level meter. As the Festival expanded, the local authority became increasingly involved as both noise advisor and noise enforcer to the Festival. In 2002 these functions were separated when Mendip District Council required the organisers to appoint their own consultants to carry out noise monitoring and control functions. Capita Symonds fulfilled this role and has done so each year since then.

David described the huge scale of the modern event. Last year the Festival was licensed for an audience of 130,000 and when all associated staff and commercial enterprises are included the total exceeds 150,000. There are five principal performance stages, five lesser stages, eleven other areas where performances take place (including theatre, circus and cabaret areas) and an outdoor cinema. One area is a 'silent' disco where dancers hear the music through radio-linked headphones. There are also some 700 stalls, many of which have their own sound system.

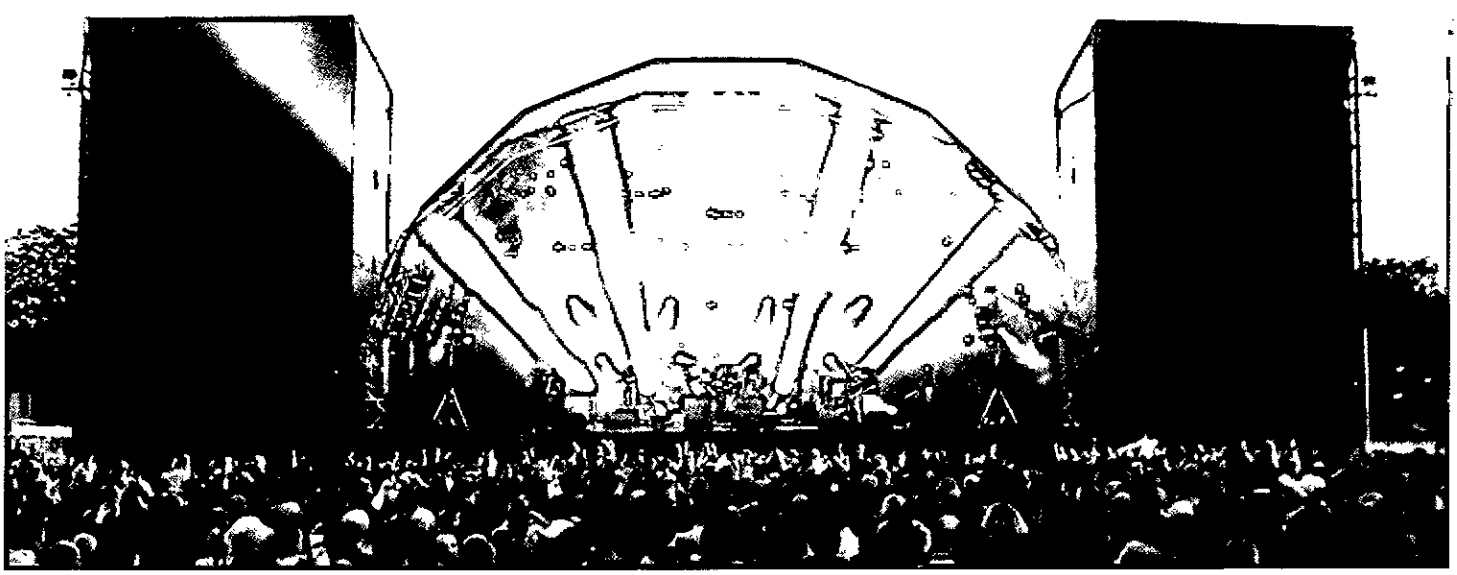
There are four fixed sound monitoring locations, and sound propagation tests are carried out on the main stage sound systems before the event commences. Any other sound systems that exceed 200 watts have to be notified in advance and then inspected and tagged on site. Last year there was a total of 160 such sound systems.

When the main stages are in operation a limit of 60dB $L_{Aeq,15min}$ is applied at the fixed monitoring points. After these stages shut down at half past midnight the requirement is that activities on the site should not be 'audible and discernable' to nearby residents. Performances in some areas continue into the early hours, with one area continuing to 6am. David pointed out that if a complaint is received it is often after the main stages have closed down.

In order to fulfil the noise monitoring and control responsibilities during the Festival, Capita Symonds operate a shift system. Last year this required 19 staff to operate, while the Local Authority's own shift system involved another eight staff dealing purely with noise issues.

A lively question session followed the presentation, and then Branch Chairman, John Hinton, led the vote of thanks to David on behalf of the appreciative audience for his excellent presentation, and to Atkins for providing the venue.

Footnote: a very similar presentation was given to the North-West branch on 20 March 2006.



British Standard to be Revised and Updated

Nick Antonio MIOA.

The revision of BS.5228: Parts 1 to 5 (Noise and vibration control on construction and open sites) has just started, with the first sub-committee meeting in March 2006. As the Institute of Acoustics' representative on the committee, Nick Antonio would like to pass on the comments of Institute members to the sub-committee for consideration. He would welcome thoughts on the Standard, its implementation, any problems that have been experienced, or any opinions there may be on any part of it. Particularly welcome would be up-to-date verified sound pressure or sound power level data, because in the past, questions have often arisen about the validity of such data.

Nick can be reached at Arup Acoustics, 8th floor St James Buildings, Oxford Street, Manchester M1 6EL, or by e-mail at **nick.antonio@arup.com**

Meeting Report: Central Branch

Tony Jones FIOA. **New Branch on track**

More than twenty intrepid souls braved a cold and drizzly evening to reach the NHBC offices in Milton Keynes on 7 March 2006 to witness the birth of the Institute's newest Regional Branch. David Watts, who chairs the Branch Committee, welcomed those attending and explained that the Branch had been created as a forum for Institute members in and around Bedfordshire, Buckinghamshire and Hertfordshire. David introduced the other committee members, Rachel Canham, Richard Collman, William Egan, Ewan MacGregor, Gary Timmins and Ralph Weston and outlined some early objectives for the Branch, including professional development, promoting acoustics in schools and involving young members.

David then invited the President, Tony Jones, to formally declare the Branch open and to cut the cake which had been specially made to mark the occasion. Tony thanked the committee for getting the Branch up and running, and looked forward to it serving a region having many members who otherwise would need to travel some distance to reach neighbouring Branches. Tony then handed back to David Watts to present his talk on the subject of the Southend Road Traffic Noise Map.

David described the background to Defra's project to derive noise maps for various towns and cities using the technique of computer modelling, with a view to establishing the ambient noise climate as required by the European Noise Directive. The methodology adopted for the Southend Noise Map was explained in some detail, including the integration of noise modelling software and GIS datasets together with the procedures used to survey noise barriers in the area and develop the corresponding barrier dataset. The noise modelling itself was carried out in accordance with *Calculation of Road Traffic Noise* methods, based on a grid of points at 10 metre intervals for a height above ground of 4 metres, without façade reflections. Six parameters were derived to define the noise climate. Overall, almost a million calculation points were used covering an area of nearly 100 square kilometres, involving a calculation time of 1350 hours spread over eight computers.

Formal welcome to new branch

Following a lively question time, which included a debate on the relative merits of modelling and measurement, David Watts drew the inaugural meeting to a close. He reminded the audience that the next meeting would be held on 6 June 2006 when Ewan MacGregor would be addressing the subject *Acousticians - Liabilities and Claims*, an issue that many practitioners will find to be of interest. Following the consumption of a considerable proportion of the cake, the location of a suitable hostelry was rapidly identified to which many of the new Branch members adjourned to reflect on the vagaries of noise predictions and life in general.

President cutting the cake

Award Notice

Nominations invited for Award for Promoting Acoustics to the Public 2006

Acoustics is a fascinating subject area which affects everyone's lives, so the Institute of Acoustics wishes to recognise those who communicate its concepts and importance to the public at large.

As the UK's professional body for those working in acoustics, noise and vibration, the IOA is inviting nominations for its 2006 Award for Promoting Acoustics to the Public. This is the second year of this Award, which was created with the object of recognizing either an outstanding piece of work during the previous year or in respect of sustained long-term activity.

The inaugural Award in 2005 was presented to Bronwen Bird of Techniquest for her innovative work on communicating acoustical phenomena to the public by developing unique science exhibits and educational programmes.

The term 'public' in the Award is intended to be interpreted widely, to mean persons without acoustical expertise, and the winner's work must be shown to have benefited the public in the British Isles. Examples of work might include:

- Writing articles for the non-acoustical press
- Authoring web pages
- Demonstrations and lectures
- Work with schools to promote acoustics
- Media work on TV or radio
- Exhibitions.

The award itself is an engraved glass trophy, which together with a written citation will normally be presented at an Institute conference.

The closing date for nominations is 15 June 2006. The award will only be made to a worthy recipient. Nominations may be made by third parties or by the individual concerned and should be addressed to the President of the Institute of Acoustics at 77A St Peter's Street, St Albans, Hertfordshire, AL1 3BN. The individual nominated need not be a member of the Institute. Nominations forms are available from the Institute of Acoustics website at **http://www.ioa.org.uk/medals.asp** or by contacting Linda Canty at the IOA on telephone **01727 848195**, or e-mail **linda.canty@ioa.org.uk**

Meeting Report

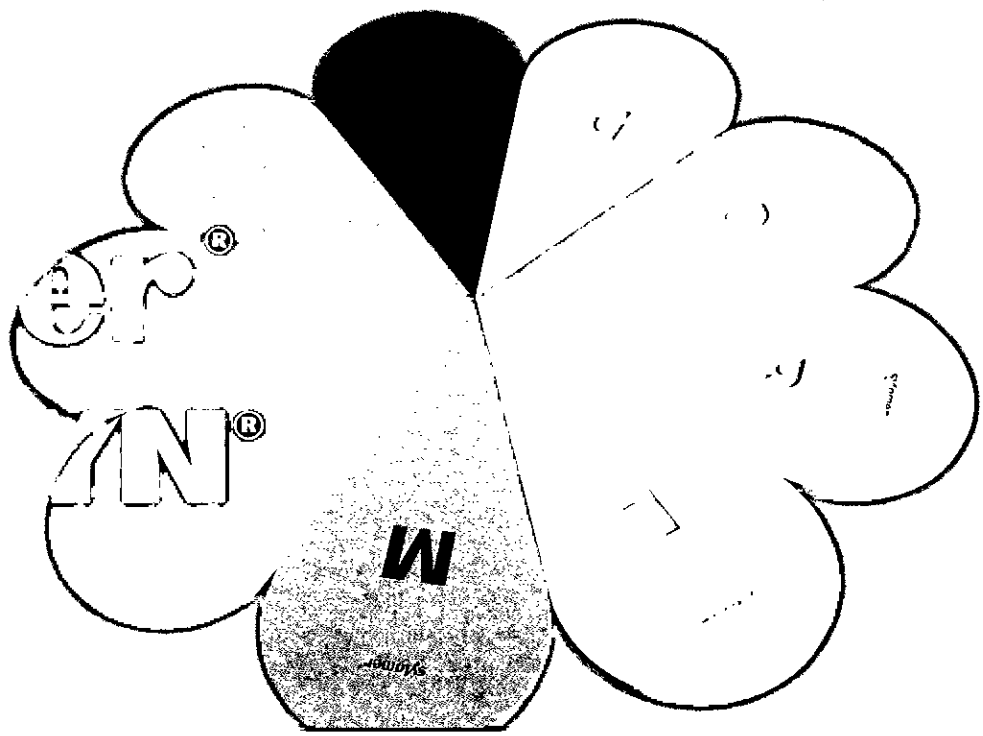
Ralph Weston FIOA. **RoSPA Safety Exchanges**

The RoSPA Safety Awareness Exchange days are billed as 'new and innovative events' which allow professionals to learn about health and safety issues specific to their working environment. As well as covering a wide remit of best practice the events also cover new legislation and HSE key issues, and offer essential networking opportunities with colleagues and peers. The idea is that delegates can address and discuss a whole range of Health and Safety issues and generally network in one day. Some 15 disciplines were represented ranging from road safety through fire, vibration white finger to behavioural safety. The IOA was asked to sponsor a table and Ian Bennett represented the IOA at Harrogate in early March whilst I sat at the 'noise table' at the Watford meeting. Delegates drop into the various tables with the expert Table Leader who is encouraged to get a discussion going so that delegates can share their experiences and solutions.

Lecture sessions were going on at the same time and these rather overran so that breaks for the delegates were all too short and the organisers plan to reduce the lecture periods at future meetings to allow more time at the tables. However, at both the meetings we each had about a dozen visitors and the main subject was the new Control of Noise at Work Regulations. We also had some of the old problems like how do we control students studying the technical side of music at a FE College when they insist they have to record the sound at maximum volume! I also had a beer bottling plant that is likely to close and a lady looking to recruit a noise specialist so I hope that she advertises through the Bulletin.

All in all these were interesting if quiet days, but it is hoped that the next one, which will take place in Edinburgh towards the end of June, will see more delegates visit our table.

The Sylomer family has some new additions' with Sylomer HD and Sylodyn completing the picture.



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Rayleigh Medal 2006 Citation

Michael Francis Evan Barron

It is in the field of auditorium acoustics that we acknowledge the contributions and achievements of Mike Barron over a period of nearly forty years. Appropriately, this award is made in Southampton where, in the Institute of Sound and Vibration Research, Mike embarked on his doctoral research in 1967, having graduated from the University of Cambridge with first class honours in engineering. Presented with Harold Marshall's hypothesis that lateral reflections are a vital ingredient of premium concert halls, Mike made a quantitative study of lateral reflections and their subjective correlate, 'spatial impression', proposing a new physical descriptor - the Early Lateral Energy Fraction - and a simple and elegant method for measuring this quantity. His thesis, for which he was awarded a PhD in 1974, places his advances in the context of the subjective effects of reflections in auditoria and provides a numerical basis for our understanding of the role of early lateral reflections, which survives to this day.

It was not long before Mike's emerging talent for considered contemplation of auditorium acoustics problems was put to the test in scale models of the Olivier Theatre and the Barbican Concert Hall. By this time he had returned to Cambridge, joining the Department of Architecture in 1975. Here, these investigations in 1:8 scale models were a prelude to Mike's development of the theory and practice of auditorium model testing at 1:50 scale, a technique with obvious practical and financial advantages, which became commonplace until threatened by the now ubiquitous, but less reliable, method of computer modelling. Typically, Mike's contribution was a judicious amalgam, combining a sound theoretical framework in which he elaborated the effects of air humidity, with painstaking measurements and a canny eye for the practical application of his work. He has subsequently tested some twenty models at scales of 1:50 and 1:25, for buildings around the world, through which he has developed a fund of understanding.

When, in the early 1980s a national survey of auditorium acoustics was mooted by the recently formed Building Acoustics Group of The Institute of Acoustics, Mike was the obvious candidate for the project. Thus was launched the most extensive survey of concert halls, theatres and multipurpose halls ever undertaken, combining the results of listening tests with objective measurements of auditorium acoustics parameters, concentrating on over forty auditoria in Britain. Selected results from Mike's study first emerged in the learned journals but were subsequently brought together in his book 'Auditorium Acoustics and Architectural Design', published in 1993. Again, we see the outcome of careful equipment design and construction (Mike built it himself), the rewards of painstaking measurement and considered argument, together with a concern for the application of his work and an enthusiasm to communicate with a wide audience. For the noise control engineer it is revealing that, far from being simply qualitative and subjective, auditorium acoustics is a quantitative discipline in which ratios as small as one decibel do matter.

In this study Mike elaborated a consistent departure from classical room acoustics theory, first alluded to in a paper published in 1973, namely that the reflected sound level is not uniform but diminishes with distance from the source. From this, Mike developed his 'revised theory' which provides new expected values for early and late energy - benchmarks for the assessment of data from individual auditoria.

Mike is a respected and modestly prolific author in refereed journals, a journal referee himself, a regular and sought-after contributor to conferences and a juror on architectural competitions, with an international reputation in his field. He has taught throughout his career and is currently a Senior Lecturer in the University of Bath, combining this with active participation in acoustic consultancy and continued research in auditorium acoustics. In 1988 Mike was awarded the Tyndall Medal of the Institute of Acoustics.

For his outstanding contributions to research and his illumination of auditorium acoustics, the Institute of Acoustics is proud to present the Rayleigh Medal for 2006 to Michael Francis Evan Barron.

Editor's Notes

Ian F Bennett CEng MIOA.

I was ruminating, on the train back from the Spring Conference in Southampton, on the clear use of language, and how it was especially important in scientific and engineering communities that we were able to understand one another. Technology coins neologisms almost daily, and the discipline of acoustics is always coming up with interesting new words and phrases (new to me, at least). 'Delinearation' has a certain ring to it, 'acousto-optic effect' is wonderfully sci-fi in character, and although not new, 'odontocetes' is a superb word for 'whales'. Just then a public address announcement was broadcast through the train 'This is Jason, your customer retail services manager…'. At what point, I was moved to wonder, did a buffet car attendant gain promotion to customer retails services manager? And while we are on the subject, why am I nowadays a customer, not a passenger? Why tell us where the first and standard class seats are to be found after everyone has sat down? Why was Birmingham New Street the 'next station stop' and not just the next station? And finally, when did stations stop being railway stations, or just stations, and turn into train stations?

My literature-studying daughter tells me that language is constantly evolving, and the most important point is that we understand what is being said, even if the grammar is imprecise or the vocabulary has changed. She is probably right, but if PA announcements are supposed to help, surely those making the announcements should be trained in how to transmit a simple, intelligible and timely message without lapsing into officialese, and surely those designing PA systems on trains can work out how to mute automatically the loudspeakers nearest the announcer's microphone to prevent feedback?

Sir Ernest Gowers' Complete Plain Words may be nearly 60 years old now, but the advice it contains should still be followed by all who transmit ideas from one brain into another. A habit was developing even in the late 1940s of using abstract words to say in a complicated way something that might be said simply and directly. The goods clerk at his local railway station, telephoning Gowers about a missing case, said 'We want you to deny indirect reception'. When asked 'What does that mean?' he replied 'We want to make sure the case hasn't reached you through another station'.

I look forward to direct reception by e-mail of contributions to the July/August issue of the Bulletin. Copy date is Friday 2 June.

Finally, and most importantly, I should like to record my personal thanks to Roy Bratby for his assistance and support, and wish him a long and happy retirement. An appreciation appears elsewhere in this issue.

Ian Bennett

Successful candidates in the 2005 Diploma Examinations

Colchester Institute

Chinery S A
Davis M L
Finlayson C L
Garland A D
Hine G R A
Hipwood C L
Mohan P
Murphy P A
O'Sullivan D F
Riches P G
Smith P L
Tee J R

Distance Learning (Bristol)

Ashmore M
Enright S P
Killick A C
Magee S D
Newhouse C H
Peskett G
Thorne M A

Distance Learning (Edinburgh)

Cleary S O
Gannon J D
Girvan N
Grant F E
Harvie-Clark J
Lewis M J
Maguire F

Distance Learning St Albans

Burdett M K E
Chilton R A
Ellis R J
Johnston I E
McCarthy T
O'Neill C
Sullivan S H J
Walker J

Leeds Metropolitan University

Buchanan D A
Calvert D M
Clarke S
Garritt D S
Hubley A E
Loughton R
Mudhar G S
Smith J D C
Willoughby M

NESCOT

Blazer D P
Bryant D M W
Butler C P
Davis C A
Evans L D
Garnett R P
Gyane T
Jeynes M R
McIntyre L J
Neville C L
Nicholls T M
Palmer R J
Parkinson D B
Priddle N
Ray J
Riahi K
Robinson E W F
Smith N C
Van Kesteren F R
Vine M D

Salford University

Bryan N
Cope R S
Cosgrove U
Faircloth S M
Figgins T
Grey R L
Kirrane S J
Martin N
Turner G A
Wood J

University of Derby

Andrews R G
Bulpitt S A
Clifford D
Currer S
Dursley L J
Dyson P M
Elder A K
Evans R M
Hall A J
Humphreys C J
Kaloya M
Levett G J
Rayner D L M
Smith A C
Stonell J A
Swanston E J
Turvey A R
Wall M J
Ward S
White A L C
Winters M S

University of Ulster

Muldoon C

University of the West of England

Broomfield A
Bufton P
Bulleid A M
Kuyser M J
Pieris Z
Snook M
Walters D G

Diploma Prize awarded with highest overall marks

Simon Mark Faircloth (Salford University)

Diploma Project ANC Prize awarded

Robert Michael Evans (University of Derby)

Four merits

Laurence Daniel Evans (NESCOT)
Simon Mark Faircloth (Salford University)
Richard John Palmer (NESCOT)
Debbie Laura Marie Rayner (University of Derby)

Three merits and a pass

Alexandra Mary Bulleid (University of West of England)
Matthew Kenneth Burdett (DL St Albans)
Robert Anthony Chilton (DL St Albans)
Robert Michael Evans (University of Derby)
Innes Edward Johnston (DL St Albans)
Peter Francis McMillan (Salford University)
Gary David Peskett (DL Bristol)
Charles Hugh Newhouse (DL Bristol)

Tyndall Medal 2006 Citation

Kirill Vjacheslavovitch Horoshenkov

Kirill Horoshenkov has quickly established a reputation as an innovative and productive researcher in several areas of engineering acoustics. He leads the Acoustics Research Group at the University of Bradford and has extensive links with researchers around the globe. His work has been supported by many grants from government and commercial sources. In the past thirteen years he has been the author or co-author of approximately seventy publications.

Kirill was born in Moscow in 1966. He graduated with an MSc in Electroacoustics and Ultrasonic Engineering from the Moscow Institute of Radioengineering and Automatics in 1989 and then worked as a Research Engineer in the Institute of Acoustics in Moscow and later as a Software Engineer. He came to the UK in 1992, first as an Academic Visitor in the Department of Electronic and Electrical Engineering at Loughborough University and soon afterwards as a Research Assistant in the Department of Civil Engineering at the University of Bradford. Kirill was awarded a PhD for work on sound propagation in urban environments in 1997. He took up lecturing posts at Bradford and was appointed to his present Chair in Acoustics at Bradford in 2005. He became a Chartered Engineer in 2005.

Prof Horoshenkov has studied the prediction and control of noise from road and rail traffic. He has developed computer models for sound propagation in complex environments and examined the effects of noise screens and sound absorbing surfaces. In addition he has established an automated physical acoustic modelling facility at Bradford which has been used to investigate the effect of trackside noise barriers on the sound propagation from high speed trains. He has a long standing collaboration with the Transport Research Laboratory in the study of road traffic noise abatement techniques.

Kirill has investigated the propagation of sound in dry and partially saturated porous materials. He has proposed several analytical and empirical models for the acoustical characteristics of porous media, one of which incorporates the pore size distribution. In the laboratories at the University of Bradford he has developed facilities for the production and testing of acoustic materials. Materials for noise and vibration control have been manufactured from recycled foam and fibrous products, and some of the processes have been patented.

Following his experience in underwater sound propagation and sound propagation in ducts with complex boundary conditions, Kirill has recently studied the assessment of the condition of underground pipes by remote acoustic sensing methods. This work has been supported by several grants from government and the water industry. Its success has resulted in the ongoing development of commercial equipment for the practical investigation of sediment levels and condition surveying of pipes.

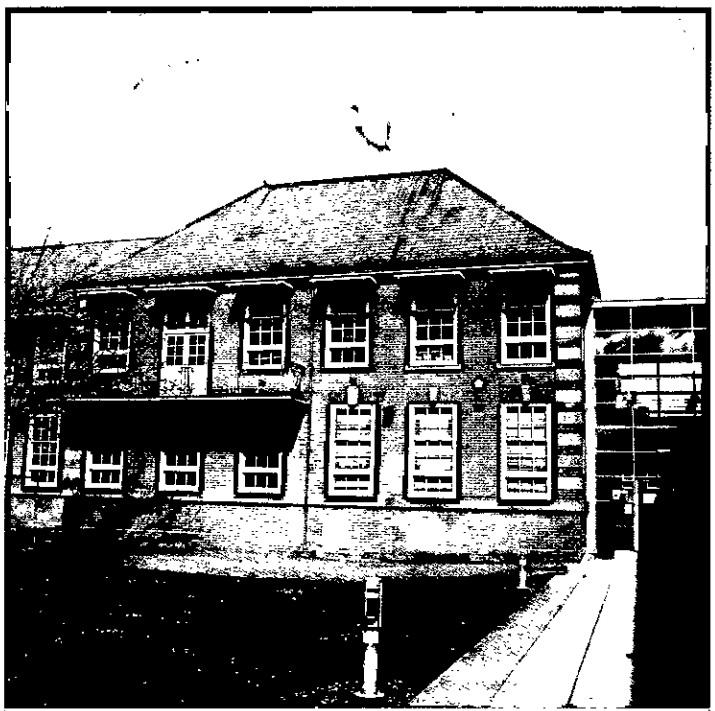
Kirill is a Fellow of the Institute of Acoustics, serving as a member of the Institute Engineering Division Committee and as Secretary of the Yorkshire and Humberside Branch. He is a Member of the Acoustical Society of America and the Russian Acoustical Society. He is a member of the EPSRC review college, an Associate Editor of Applied Acoustics, and has been a session organizer at several recent international conferences on acoustics.

Kirill Horoshenkov is a young researcher with a proven research record who promises substantial future achievements. The Institute of Acoustics is delighted to award the Tyndall Medal for 2006 to Kirill Horoshenkov.

Spring Conference 2006

Ian Bennett CEng MIOA. **Editor**

Around 200 delegates from academic and industrial circles attended the 2006 Spring Conference of the Institute, held at the Avenue campus of the University of Southampton on 3 and 4 April. The conference title 'Futures in Acoustics: Today's research - Tomorrow's careers' proved a powerful magnet to researchers and students from many UK and more distant universities and institutions, reflecting Bridget Shield's original suggestion that the Conference should particularly appeal to younger acousticians. Nonetheless, there were several 'grey eminences' to be seen - and engaged in conversation - during the conference: perhaps acousticians tend to be young at heart anyway.



The Avenue campus of Southampton University was the setting for the Spring Conference

Accommodation was at the modern and comfortable Highfield Halls

Mike Barron is presented with the Rayleigh Medal 2006 by Tony Jones

Kirill Horoshenkov receives the Tyndall Medal 2006 from the President, Tony Jones

Excellent spring weather greeted the delegates on arrival on the south coast, and this auspicious start was more than matched by the quality of nearly 100 papers covering almost every conceivable branch and nuance of the acoustical field, and focussing on the twin themes of research and employment in acoustics. In pursuance of the second theme, a very successful innovation was the Careers Forum held on the Monday afternoon. Nine invited speakers representing different acoustical 'flavours' explained to an enthusiastic audience their own experiences of working in fields from acoustical consultancy to electroacoustics and medical physics.

The formal presentations were arranged into four parallel sessions, and judging by the transfer of delegates between sessions this was a popular way of allowing each to mix and match the programme to suit individual requirements. Two plenary sessions were also held so that Mike Barron and Kirill Horoshenkov could present the Rayleigh Medal Lecture and the Tyndall Medal Lecture respectively. Mike spoke about the development of concert hall design over a 111-year history, and Kirill discussed at length the characterisation of acoustic porous materials. A third invited speaker, Robert Evans of British Gypsum, introduced the Building acoustics sessions by presenting the paper associated with his ANC Prize for the best Diploma project, on 'Cinema wall design'.

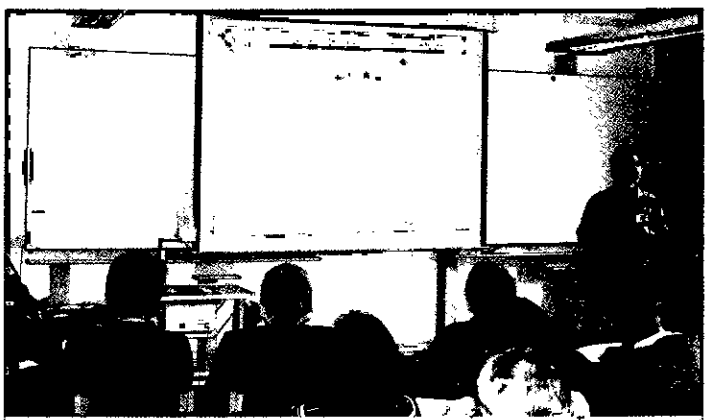
The session topics were: Active and virtual acoustics; Acoustical oceanography; Aeroacoustics (two sessions); Audiology (two sessions); Building acoustics (two sessions); Engineering acoustics and noise control (two sessions); Environmental acoustics, noise transportation and sustainability (four sessions); Musical acoustics (two sessions); Novel applications of acoustics (three sessions); and no fewer than five sessions on Underwater acoustics: Field measurement and prediction; Ultrasonic surgery; Microbubbles injected into the body; Cavitation; and Potential applications for industry.

Given the emphasis of the conference on younger acousticians, additional features were suggested and included. Anne Carey suggested and organised a Careers Forum for the afternoon of Monday 3 April. In addition to providing a venue where employers could meet potential future employees, specific representatives of a range of careers were invited to give a short address on employment in their area. These people included: Andy Simpson (Jaguar Cars Ltd) on careers in noise, vibration and harshness (NVH) in the automotive industry; Hilary Notley (RAF) on careers in defence and aerospace; Jackie Shipley (Bath Royal United Hospital) on careers in medical physics, especially medical ultrasound); Mark Lutman (ISVR) on careers in academia; Stephen Turner (Casella Stranger) on careers in consultancy and noise control; Kelvin Griffiths (Harmen Becker) on careers in electroacoustics; and Graham Frost (PC Werth) on careers in audiology.

The technical papers presented are summarised below, in broadly chronological order, but for convenience the papers under a particular session heading are grouped together.

The **Rayleigh Medal Lecture: The development of concert hall design - a 111 year experience** was an excellent and fascinating opener for the technical proceedings. Concert hall design is something the public most often associate with the acoustician's work, and who better to talk about it than this year's Rayleigh Medal winner, **Mike Barron**, a world authority in the field. He provided a comprehensive walk through the history of concert hall design from 1895 to the present day. To acousticians, the significance of 1895 is that this was the year Wallace Sabine was first commissioned to improve lecture hall acoustics at Harvard University, work which resulted in his now famous theory

The serious business begins: technical sessions took place in four different lecture theatres all in the same building



Technical sessions

of reverberation. Prof Barron called on his comprehensive depth of knowledge to lead us to the solid scientific foundation which characterises concert hall design today, describing the importance of early lateral reflections and his part in the development of their theory. He plotted a timeline of the different eras in concert hall design, from the shoebox designs popular in the classical era, through to the fan-shaped halls of the to modern terraced designs, first seen in 1963 and still popular for example in the Bridgewater Hall in Manchester. He pointed out that although understanding has advanced immeasurably since Sabine's era there has recently been a return to more conservative designs, possibly indicating that there is still much to be learned about the complex phenomena involved in listening to music.

Ultrasonics 1: Field measurement and prediction was chaired by Victor Humphrey and Paul Fox. It consisted of three papers describing optical techniques of measuring ultrasonics in fluids. In the first paper **Paul Morris** (University College London) described 'The developments of a 50MHz Fabry-Perot type fibre optic hydrophone for the characterisation of medical ultrasound fields'. The approach showed considerable promise, although work continued to reduce the effect of resonances associated with the hydrophone structure. **Pete Theobald** (National Physical Laboratory) continued the optical theme by discussing "The use of optical techniques to map the acoustic field produced by high frequency sonar transducers". The approach used a laser Doppler vibrometer (LDV) to measure the phase changes introduced in the optical path of a laser beam aimed across the acoustic field. The resulting data was wed to create a tomographic reconstruction of the field cross-section. This was in good agreement with hydrophone scans. **Martin Cooling** was unable to give his presentation owing to illness, so it was presented by **Victor Humphrey** (ISVR, University of Southampton). 'Optical measurement of acoustic field in water' continued the investigation of LDV methods for field measurements, and described the factors that influence and accuracy of such systems.

Ultrasonics 2: Ultrasonics surgery, chaired by Gail ter Haar and Eleanor Stride covered a range of exciting developments in this rapidly expanding field. It began with a paper presented by **Constantin Coussios** from the Department of Engineering Science (Oxford University) on the use of

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controlled acoustic cavitation to enhance and monitor cancer treatment by high-intensity focused ultrasound (HIFU). The aim of this work is to overcome the relatively long treatment times that are a current limitation of this type of therapy, by using cavitation bubbles to increase the rate of energy absorbed by tissue. The nonlinear signal produced by the bubbles also provides a means of monitoring the progress of the treatment in real time. The HIFU theme was continued with two papers from the Institute of Cancer Research, the first presented by **Jim McLaughlan** on a passive cavitation detection system for the monitoring of acoustic emissions to be used in the optimisation of focused ultrasound surgery treatments. The current objective is to relate the nonlinear cavitation bubble signals to the progress of HIFU treatment and to develop a system which can be incorporated into a clinical HIFU device. This paper was followed by a presentation from **Paul Godden** on the numerical modelling of high intensity focused ultrasound arrays by finite volume methods. The aim of this work is to provide a model to enable the planning of HIFU treatment for which an accurate map of the ultrasound field is vital. Towards the end of the session, the focus moved from HIFU to lithotripsy, with a paper given by **Fiammetta Fedele** on a joint project between Guys and St. Thomas' Hospital, ISVR and Precision Acoustics, to develop an ultrasound passive monitoring system for extracorporeal shock-wave lithotripsy. This will detect the acoustic emissions generated during the fragmentation of kidney stones, providing an indication of treatment success which cannot be obtained using conventional techniques.

Ultrasonics 3: Microbubbles injected into the body was again chaired by Eleanor Stride, this time jointly with Tim Leighton. It started with a strong showing from Dundee University and an extended presentation by **Paul Prentice** on experimental observation of cell membrane rupture by cavitation derived microjetting. The study examined the phenomenon of sonoporation (the enhanced permeability of cell membranes induced by exposure to ultrasound) and its relationship to microbubble behaviour, via high speed camera observations of the interactions between microbubbles and cells. The second paper was given by one of the session chairs, **Eleanor Stride** (University College, London) and examined the implications of the multiple scattering of ultrasound in diagnostic and therapeutic applications of contrast agent microbubbles. The aim was to determine the experimental error involved in contrast agent characterisation due to multiple scattering and the resulting loss in efficiency for both drug delivery procedures and novel contrast imaging techniques. An example of just such a technique was presented in the third paper given by **Kevin Chetty** (Imperial College) on modelling the nonlinear microbubble response to coded, multipulse sequences. The object of this work is to improve the detection of microbubbles when using ultrasound to image deep within the body by using a combination of chirp excitation, pulse inversion and amplitude modulation to excite the bubbles. The final paper was also given by a member of the Dundee group, **Janis Burns**, who presented a combination of experimental and theoretical work on the dynamic reaction of contrast agent microbubbles to high pressure pulsed ultrasound, in particular the formation of microjets by bubbles at rigid boundaries.

Ultrasonics 4: Cavitation was chaired by Constantin Coussios (University of Oxford). The session focussed on novel methods of detecting and monitoring cavitation. **Mark Hodnett** presented some promising preliminary results on the performance of the NPL cylindrical cavitation sensor in a well-predicted, controlled cavitation field. **Doug Offin** (University of Southampton) introduced the audience to an existing new technique utilising micro-electrodes to detect and monitor the behaviour of cavitating microbubbbles as they flow past a custom-built sensor. Finally **Chris Vian** (also University of Southampton) proposed to use the effect of surface erosion induced by cavitating microbubbles on microelectrode current to detect and monitor cavitation.

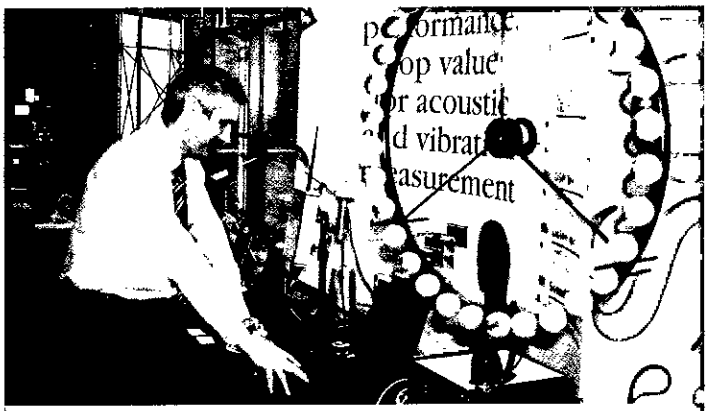
Ultrasonics 5: Potential applications for industry was chaired by Sandy Cochran and Martyn Hill. It began with a paper by **Jamie Condliffe** and four University of Oxford colleagues, on the development of a technique to assess particle distribution following needle-free injections. He described an acoustic microscopy technique for use in assessing the depth of transdermal delivery of drugs in powder form. **Rosemary Townsend** (University of Southampton) then described the modelling of ultrasonic devices used for micromanipulation of particles using acoustic radiation forces. **Sandy Cochran** then presented a paper on two dimensional piezocomposite ultrasonic arrays with applications in non-destructive testing, and **Geun-Tae Yim** (University of Southampton) spoke about the use of acoustics for real-time on-line monitoring of ceramic slip in pottery pipelines, the 'slip' referring to the liquid ceramic slurry rather

Technical sessions

Technical sessions

Kirill Horoshenkov gives the Tyndall Medal lecture

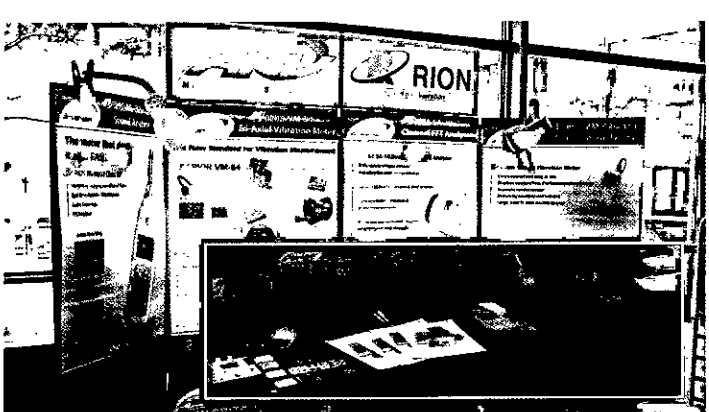
An attentive audience for the Careers Forum



Steve Thomas demonstrates AcSoft's version of the London Eye

Brüel and Kjær (Institute Key Sponsor) showed the very latest in sound measuring instruments

IAC's stand (exactly as it says on the tin)



ANV exhibited the latest range of Rion products

than a phenomenon involving loss of friction. Problems are caused by bubbles in the slip which become voids in the finished article of tableware, leading to its rejection. The session was brought to a close by **Hanne Hirsimki** (University of Southampton) who described electrochemical measurements of optically induced cavitation events.

Building acoustics filled two sessions, one on each of the two days. Jian Kang chaired the first, which began with presentation of this year's ANC Prize for Best IOA Diploma Project to **Robert Evans** of British Gypsum, by Peter Hepworth (Hepworth Acoustics) on behalf of the ANC. This was followed by a presentation by Robert about his work on cinema partition wall design, as Cine-UK Ltd introduced new acoustic requirements for the internal walls to be built in their multiplex cinemas. Using the existing specification and past test evidence, a series of laboratory airborne sound insulation tests was conducted to evaluate the performances of different systems against the new requirements. The cavity depth, insulation specification and board specification were all varied as part of the test programme. From these acoustic tests, several possible specifications met the Cine-UK requirements.

School acoustics was a hot topic in the building acoustics sessions. The application of Building Bulletin 93 results in a design conflict between current architectural trends and the achievement of the STI requirement for speech intelligibility. This has resulted in the standard being seen, by many of those involved in school design, as an obstacle to creative design. **Emma Tate-Harte** and Bridget Shield (London South Bank University) reported a survey of existing open plan classrooms, indicating that achieving satisfactory acoustic conditions depends on the type of organisation and management strategy used in the classroom as well as its architectural design. **Matthew Hyden** (PDA Acoustics) looked at the experience of a consultant with regard to detailing and site issues encountered on the way to successfully designing schools to meet BB93, suggesting that correct acoustic detailing and quality of workmanship on site is essential to ensure acoustically 'good' schools.

On Tuesday, **Steve Dance** and **Roger Dentoni** (London South Bank University) presented a user-friendly and fast web-based image source model to predict speech intelligibility in classrooms. With the commercial software CATT as a baseline, it was shown that the web-based model can predict sound pressure levels and speech transmission index (STI) well, but reverberation time was somewhat overestimated. **Thomas Mitchell** (University of Exeter) then reported a series of measurement results in temporary school classrooms, given that when older existing buildings are relocated they must meet the requirements of the previous guidelines BB87. The final paper in the session was by **Jane Horner** and Keith Peat (Loughborough University) on the transmission loss of large rectangular apertures in hard screens, by developing simple approximations for the modal coupling terms for the lower cut-on modes. Whist the model was developed in the field of aeroacoustics, it was open to discussion regarding its possible application in building acoustics.

The first session on **Environmental acoustics, noise, transportation and sustainability** chaired by Yiu Wai Lam (Salford University) opened with a presentation by **Ziyan Xing** (University of Sheffield) on a cross-cultural study of acoustic comfort in residential areas in the cities of Sheffield (UK) and Beijing (China). There was an interesting discussion on the differences between the two cultures and the correlation between demographic factors and the nature of the sound. The second presentation was by **Joan Clares Blanco** (University of Southampton) who looked at the possible effect of noise levels on the published property prices in the Birmingham area. The result somewhat agreed with the findings of a similar study in London that the house prices do not seem to be strongly affected by outdoor noise levels. The correlation is likely to be multi-dimensional and other demographic factors and cultural preferences would have to be considered. The third paper by **Ieish Gamah** (University of Southampton) was on the perception of aircraft noise. Instead of the usual angle of annoyance, the study focused on the 'ignorability' of the noise, and aimed to determine the prominent features in aircraft noise that draw people's attention. The final presentation was by **Keith Attenborough** (University of Hull) on the prediction of ground vibrations resulting from outdoor explosions. This paper focused on the physics of the problem and the theory of the prediction. Ground vibration is relevant to environmental noise created by many other sources such as trains above and underground, and the paper provided a scientific basis for its assessment and prediction. Overall the session provided an interesting mix of papers on the perception of environmental noise, how it affects property values, and the actual prediction of propagation of noise and ground vibrations, and should be of great value to a large spectrum of specialists working in the area of environmental noise.

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The other two environmental acoustics sessions, on Monday afternoon and Tuesday morning, were chaired by Victor Krylov (Loughborough University). The first paper was presented by **David Waddington** in a very lively way. The subject of his joint work with Andrew Moorhouse (both being with Salford University) was the interaction within dwellings of transportation noise with tones generated by domestic equipment. The paper audio recordings of examples were presented to the audience, including very disturbing low frequency modulated tones. Although not identified as noise nuisances, the examples were likely to be of particular interest to Environmental Health officers involved in the assessment of low-frequency noise complaints. The second paper, presented by **Jochen Eisenblaetter** and written jointly with Stephen Walsh and Victor Krylov (all Loughborough University) was about experimental investigations into the air pumping effect at the tyre/road interface. Jochen reported some new results of experimental investigation into the air pumping mechanism of tyre noise generation obtained on a reduced-scaled model of solid rubber tyre mounted onto the roller of a chassis dynamometer. Although road/tyre noise in general has attracted a lot of attention during the last decade, the air-pumping mechanism remains relatively unknown. The reported new results could be used for its better understanding and theoretical modelling.

Next, some noise and vibration measurements in military fast-jets were presented by **Andrew Hounslea** (RAF Henlow). He pointed out that making noise and whole-body vibration exposure measurements in a fast-jet posed more challenges than typical noise and vibration exposure assessments. A suitable measurement system was designed for use on the RAF's fleet of fast jets. The last paper of the afternoon was 'Theoretical and numerical comparison of SNGR method and acoustic analogy', by **Mahdi Azarpeyvand** and R H Self (both University of Southampton). The main focus of the paper was the comparison of several methods of analysis of jet noise, including SNGR method and method of acoustic analogy.

Environmental acoustics on day 2 began with an assessment of the predictive accuracy of road traffic noise by **Heng Tak Chui** (Sheffield Hallam University), jointly with Raymond Heng (also Sheffield Hallam University) and K Y Ng (Singapore Polytechnic). Its main focus was the discussion of the ability of commercially available predictive software to provide results comparable with actual measurements. The study compared actual field measurements along major roads and expressways in Singapore against commercially available software. The second paper, a study of road traffic noise on high-rise buildings in Singapore by the same three authors was also presented by **Heng Tak Chui**, and the topic was actual noise measurements in high-rise buildings built close to major highways. The measured noise levels were found to be dependent on factors such as road speed, traffic volume, traffic composition, distance of buildings from the road, and the height of the buildings.

The last paper was concerned with a customised lifecycle assessment model for noise barrier design and was by Jennifer Joynt (University of Sheffield and RPS Consultants) and **Jian Kang** (University of Sheffield), who presented it. It was reported that through an extensive review of both the literature and of the available lifecycle models, a framework and model has been established to enable the possibility for evaluation of lifecycle assessment and sustainability of various noise barriers. A single overall index has been proposed for relative comparisons. By using the model, typical noise barriers have been analysed and compared.

Aeroacoustics filled two sessions, one on each day. The first Monday paper, in a session chaired by Mike Fisher, consisted of three papers by researchers at the University of Southampton. **Fabrice Castres** spoke about an inverse technique for the determination of modes from a turbofan inlet. The feasibility of locating a microphone array on the turbulence control screen upstream of an aero-engine inlet duct for the determination of the modal content of the radiated sound was explored. It was demonstrated that the appropriate design of the microphone array was an essential feature in obtaining high quality results. **Tze Chong** dealt with the design of a quiet open jet facility, which took the form of a progress report on the development of a major new facility at the ISVR. The initial application is the determination of aerofoil self-noise. **Chris Lowis** presented an interesting and lively paper about the measurement of broadband sound in aero engine ducts. Data from a set of wall-mounted in-duct microphones could be processed electronically to focus either on a stationary source (a stator blade, for example) or a rotating source such as a

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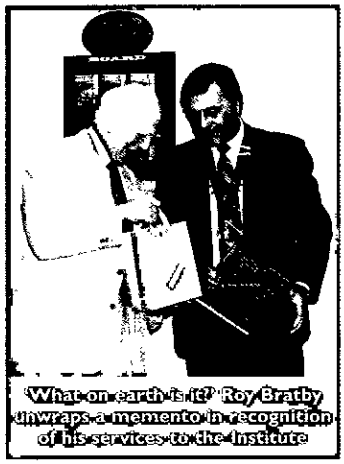

What on earth is it? Roy Bratby unwraps a memento in recognition of his services to the Institute

Trevor Cox introduces his vegetable

This is the biggest one I could get

The radish clarinet version of 'Stranger on the Shore'

The bass Bernouilli drainpipe is demonstrated

The pipe band, musical(!) director Trevor Cox

A more dramatic demonstration of Signor Bernouilli's famous discovery

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rotor blade. Hence the relative contributions of two such sources, at the same frequency, could be determined. Typical results were presented and some current limitations were identified.

The second Aeroacoustics session, chaired this time by Jeremy Astley, also consisted almost entirely of University of Southampton presentations. It began with **Emmet English**'s work on the measurement of the plane wave aeroacoustic characteristics of an exhaust pipe, then went on with **Chris Brooks**' presentation entitled 'Axially segmented acoustic liners for turbofan engine bypass ducts: a method for preliminary design iterations and optimisation'. He was followed by **Eugene Deane** who described turbulent wake predictions for broadband noise calculations, and **Lars Enghardt** (German Aerospace Centre) discussed the determination of broadband noise in flow ducts. Finally, turbulence cascade interaction noise was investigated in a paper by **Vincent Jurdic**.

Engineering acoustics and noise control was chaired by Bob White (ISVR, Southampton). The presenters of the four papers were **Vasil Georgiev** (Loughborough University, two related papers), **Andrew Elliott** (Salford University) and **Tomas Evans** (Salford University). The topics covered ranged from finite element analysis to acoustic measurements. The first paper discussed FEA of vehicle interior noise in a series of structural models of increased complexity, and the second the experimental and numerical investigation of structure-borne interior noise in a simplified model vehicle. In-situ methods for structure-borne sound power prediction and source characterisation were described in the third presentation, and finally, the presentation by Tomas Evans included audio output of the measured and simulated noise from small centrifugal fans for use in virtual acoustic prototypes. The younger members of the audience could detect differences, but not some of the older ones!

There were four papers in the second session, three from PhD students at ISVR and one from industry. The first ISVR speaker was **Yohlo Aoki** (co-authors Paulo Gardonio and Steven Elliot) who described a parametric study to investigate the properties active control with piezoelectric patches. This was followed by her ISVR colleague **Chris Gonzales Diaz** (co-author Paulo Gardonio) who is also working on active control, looking at feedback control laws for inertial actuators. A first year PhD student at ISVR **Azma Putra** (co-author David Thompson) then described work on the radiation efficiency of unbaffled plates using computer simulations. The final paper described recent innovations in the design procedures for loudspeakers using magnetic finite elements and acoustic boundary elements, which was given by **Patrick Macey** of PACSYS Ltd, Nottingham. The standard of presentation and the rigour and quality of the work was high throughout, and it is a pity that this session (the final one of the conference) was not better attended.

Novel applications of acoustics began with **Olga Umnova** (University of Salford) who presented the results of analysis of a two-dimensional model of multiple acoustic scattering and sound transmission by periodic arrays of circular cylindrical bodies that produce transmission and attenuation bands. The potential application is to the construction of traffic noise barriers. She illustrated the effects on insertion loss of covering the cylinders with materials having a range of surface impedances. It was concluded that porous concrete coats and the use of hollow core cylinders substantially improved attenuation performance. **Richard Lord** then explained the design and principle of operation of an apparatus for exploiting the acousto-optic effect in air to image sound scattering by solid objects. The application of the technique was illustrated by images of sound fields scattered microphones and sound level meter. Future work will be aimed at quantitative resolution of sound pressures and 3-D imaging using tomographic reconstruction techniques. **Keith Attenborough** summarised the principal features of a mathematical model for estimating the vibrational response of ground to the incidence of an airborne shock wave generated by a source fairly close to the ground surface. There exist two principal modes of transmission of shock disturbances to a remote point in the ground: acoustic-to-seismic coupling in which the airborne sound couples to a compressional wave in the porous ground as it traverses its surface; and a mainly sub-surface path that involves a Rayleigh (leaky) wave that is induced in the ground by the shock wave in the vicinity of the source. Descriptions were presented of a laboratory apparatus for generating airborne shocks and a means of measuring the response of model 'ground' materials in a test tray. The existence of the two forms of wave was illustrated by the signal produced by an accelerometer buried in the 'ground'. Parametric mathematical models were used to fit the observed variations of peak acceleration and latency and thus empirically to estimate numerical coupling coefficients.

Pre-buffet drinks in the Avenue campus foyer

Sounds of Steel prepare for their performance

Drinks and intelligent conversation

Caribbean buffet...

...with the compulsory pineapple

So this is what acoustics is all about

Gary Seiffert presented the results of experiments aimed at evaluating the levels of sound and vibration necessary to remove deposits of electrically precipitated particulates such as those extracted from coal-fired power station flues that are deposited on large metal plates. The purpose was to assess whether it might be practicable to replace the current method of rapping the plates with a metal hammer which damaged the plates. A series of still and video shots showed the debonding process in operation. It was interesting to hear that the minimum effective vibration levels were rather similar, and not significantly frequency dependent, in cases of samples collected from five different power stations using different fuels and combustion systems; however they were substantially different in the case of gypsum powder. The effective sound levels were also similar, but decreased with increasing frequency. It was shown that the mutual cohesive forces between particles was substantially less than the adhesive forces between the particles and the collecting plate, so that neither sound nor vibration could completely clean the plates: this was in accordance with theoretical models. Future work will simulate collector plate roughness. **Chris Ham** presented the mathematical basis for estimating the deviation of acoustic modal densities of two-dimensional annular spaces from their asymptotic values. He succeeded in the challenging task of interesting and enlightening an audience which was largely unfamiliar with this field of theoretical study

The second 'novel applications' session followed the Tyndall Medal lecture by Professor **Kirill Horoshenkov** (University of Bradford) reported below — indeed, two out of the three papers were related to Kirill's current research. The first was given by his research student, **Amir Khan**. It concerned the manufacturing and testing of new types of sound absorbing materials from recycled components. A mix of PVC granules and fibres from waste carpet were being melted and mixed together with water and binder to make materials either with good sound absorption or good impact absorption. **Kirill Horoshenkov** himself then took us into the dark malodorous world of the sewer. Water companies need to know the location and characteristics of the sediment content when the sewers are relatively dry so that they predict where they might have flooding and leakage problems when the sewers are full. Through fascinating robot CCTV footage, Kirill pointed out the characteristics of wall roughness, collapse and the various (unmentionable) sediments. The idea behind a novel application of acoustics is that analysis of sound propagation in the sewer can be used to locate and determine characteristics of the sediment. **David Sharp** (Open University) then took time away from his organising the simultaneous musical acoustics session and brought us back into sweeter air. He explained work done by one of his research students (Victor Chilekwa) into locating multiple leaks in air filled pipes by means of a numerical optimisation approach based on acoustic pulse reflectometry.

The third set of novel applications of acoustics included papers that varied widely in topic, from psychoacoustics through the detection of buried objects to engine condition monitoring. In the first paper of the session, **Victor Krylov** (Loughborough University) demonstrated aquatic propulsion by wave-bearing fins, in a manner simiilar to sting rays, using a working model shown on video. The propulsive efficiency was found to vary strongly with wave amplitude: when the ratio of amplitude to distance travelled in one period - called Strouhal number by fish propulsion researchers - reached about 0.2, the efficiency was optimised. Apparently fish use a similar Strouhal number when swimming.

Jian Jiang (University of Manchester) explained how he was able to use standard one-dimensional system modelling, with some non-standard pressure transducers able to withstand the hot environment in a diesel engine exhaust system, to identify the acoustic source strength and impedance associated with engine firing. Fuel injector malfunction could then be detected from the reconstructed time waveform of source pressure. **Pedro Novo** (Salford University) then described a method of characterising the acoustic environment produced by a crowd of people talking (as in a pub), in terms of interaural cross-correlation. **Keith Attenborough** (University of Hull) showed how measurements of seismic response to incident sound could be used to detect buried objects like landmines. A laboratory setup used plastic boxes buried in sand, with the seismic response detected by an accelerometer on the sand surface. Nonlinear features of the response proved to be an aid to identifying the object. Finally **Fouad Bechwati** (Salford University) presented some measurements of surface impedance on activated carbon samples. The novelty here lies in the extremely small (a few atoms wide) flow passages in this material. Members of the audience were privileged to be among the first to learn about nanoacoustics, a topic which will surely feature prominently at future conferences.

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Audiology also attracted sufficient papers to fill two sessions, the first of which was chaired by Mark Lutman. Acoustic models of cochlear implants were explained by **Carl Verschuur** (ISVR), the aim being to provide an overview of approaches to the acoustic modelling of cochlear implants, and to report findings from two experiments that aimed to determine the effect of acoustic model parameters on perception of acoustic-phonetic information in speech. Binaural interaction using transposed stimuli and steady state auditory evoked potentials (SSAEPs) were then studied by **Tim Simpson** (King Edward VII Hospital). He investigated the use of transposed stimuli to evoked SSAEPs in normal hearing subjects. The concluding paper was presented by **Robert Pyerzicki** (ISVR) and dealt with two models for fluid-structural waves in the organ of Corti. The active mechanism, often referred to as the cochlear amplifier, postulated to enhance the response of the cochlea to low-level stimuli, is assumed to be controlled by the action of the outer hair cells located within the organ of Corti.

Graham Frost then took over the chair, and presided over four further audiological papers. **Mark Lutman** (ISVR) presented the development of a telephone hearing test in the English language, based on work in the Netherlands by means of which the general population could self-screen the hearing. **Amar Sood** (ISVR) spoke about methods of compensation for the acoustic transfer function of earphones and the ear canal, which is a matter of particular importance in audiological procedures that deliver a test stimulus directly into the ear canal. **Daniel Rowan** (ISVR) discussed the binaural perception of high-frequency complexes, which depend on the interaural time difference and interaural level difference between a signal arriving at the two ears. The session was brought to a close by **Stefan Bleeck** (University of Southampton) with his computational model of the temporal adaptation patterns of neurons in the ventral cochlear nucleus, one of the first processing stations for acoustical information reaching the ear.

Active and virtual acoustics was chaired by Philip Nelson. The first paper, 'Virtual representation and qualification of soundscapes of open public spaces', was presented by **K Angelakis** (Technical University of Denmark) in a paper co-written with J Alvarez (also TUD) and K Saher (University of Technology, Netherlands). This was interesting work but left a number of questions to be answered.

An auditory process model for the evaluation of virtual acoustic imaging systems was then very clearly described by **Mun-Hum Park** (ISVR) on behalf of his co-authors Philip Nelson (University of Southampton) and Y Kim (Samsung Advanced Institute of Technology, Korea). Third came **Mahdi Azarpeyvand** (ISVR)'s 'Active control of sound radiated from a spherical source in an acoustic half-space by using a radially vibrating spherical baffled piston' which described some interesting work on the fundamentals of active noise control. A smart double panel with active damping units located in the air cavity was then discussed by **Neven Alujevic** (ISVR), and the session was drawn to a close by **P Mannerheim** (University of Southampton) who overcame some slight technical problems with the presentation to tell the audience about image processing algorithms for listener head tracking in virtual acoustics.

The **Tyndall Medal Lecture 2006**, given by Kirill Horoshenkov (University of Bradford) began the second day's proceedings. His 'Characterisation of acoustic porous materials' began with a biblical reference allegedly dealing with the reduction of reverberation in a large enclosed space, but Aristotle provided a more reliable account of acoustical absorption by porous media in his Problemata, when he noted that spreading the floor of a theatre with straw reduced the volume of sound emitted by the chorus. From this promising beginning Kirill went on to describe the state of knowledge and the effects of porous media both indoors and out of doors, and considered the larger range of acoustic models available to predict their properties. The three distinct types of porous media - rigid frame, elastic frame, and limp - were discussed, and the presentation then concentrated on the modelling and characterisation of rigid frame porous media. He reviewed the standard theoretical basis for modelling, then went on to appraise the one-parameter Delany and Bazley model, the two-parameter Attenborough model, before investigating the accuracy and validity of three-parameter and ever more advanced models. Finally, he made some recommendations for future work and posed three challenges, possibly the most immediate of which was the use of waste and recycled materials as imaginative alternatives for the manufacture of porous and acoustically absorptive products.

Acoustical oceanography was the final Room A session, with Eleanor Stride and Paul Fox jointly presiding over four excellent talks covering a range of topic areas. **Chris Powles** (ISVR, Southampton) opened by speaking about passive acoustic monitoring techniques for the localisation of whales in oceans, **Gary Robb** (NOC, Southampton) then followed with a review of techniques for measuring bubble populations in gassy marine sediments, and **Daniel Finfer** (ISVR) discussed difficulties in establishing and interpreting sound and noise levels from marine mammals and sonar in shallow bubbly coastal waters. Finally the session was closed by **Tim Leighton** (ISVR) who discussed some acoustical properties of Titan and Europa and their potential exploitation using low power acoustic sensors. All the papers precipitated a good number of audience questions, making this a particularly interesting (and well attended) session.

Tony Jones draws the prize winner's name for the IAC champagne

Philip Rossiter (right) pictured before winning his champagne

Musical acoustics was first chaired by Murray Campbell, Edinburgh University. The first musical paper was given by **Colin Gough** (University of Birmingham). With many examples of real and synthesised violin sounds, Colin demonstrated the importance of vibrato in violin timbre, and discussed how this is affected by the transient response of the instrument. In the second paper **Peter Davies** (ISVR) gave a detailed acoustical discussion of the tin whistle, including an explanation of the non-linear aeroacoustic processes which generate the sound. **Ian Drumm** (Salford University) then presented some of his recent work on the simulation of musical performances within virtual environments using adaptive beam-tracing.

In the second session, chaired by Peter Davies, **Claudia Fritz** (Cambridge University) described work which she had carried out in France and Australia on the effect of vocal tract resonances on clarinet playing, using an artificial (mechanical) player to blow the instrument. This was followed by **Christos Karatsovis** (ISVR)'s paper on the cepstral analysis of piano notes, and **Jim Woodhouse** (Cambridge University) described perceptual tests with virtual violins, with a number of audio demonstrations. The normal modes of an 18-inch crash cymbal were investigated by **Gerry Swallowe** (Loughborough University), and **Patrick Gaydecki** (University of Manchester) introduced the audience to the next generation multi-channel real-time digital signal processing platform for audio and acoustic network evaluation.

David Sharp was the final chairman for musical matters, and the third session began with a talk by **Alistair Braden** (University of Edinburgh) discussing whether bends in the tubing of a musical wind instrument have a significant

effect on the input impedance (and therefore the resonances) of the instrument. A basic outline of the multi-modal theory involved was provided and some of the problems involved in implementing the theory for real instruments were discussed. A presentation by **Alistair Disley** (University of York) was concerned with the adjectives musicians use to describe the timbres of sounds. Listening tests were described which investigated the level of agreement between subjects on the usage of various timbral descriptors, and then ranked various instrument sounds using a chosen set of timbral descriptors. The next paper was by **Michael Newton** (University of Edinburgh). He talked about the physiology of the vocal folds and the mechanism by which they oscillate. High speed video of the oscillation of artificial vocal folds and particle image velocimetry vector maps of the flow through them were shown and discussed.

Another student from the University of Edinburgh, **Rob MacDonald**, came next. He described his recent work investigating non-linear losses at woodwind tone holes. Through a series of particle image velocimetry vector maps, he showed that at high blowing pressures, boundary layer separation can occur at a tone hole, with vortices and jets being formed. This effect was shown to be much less in undercut tone holes with the non-linear losses reduced. **Darren Hendrie**, a fourth student from the University of Edinburgh, presented the next paper. He described a recently developed method of accurately measuring input impedance which does not require precise knowledge of the propagation constant. Both input impedance measurements and bore profile reconstructions obtained using this method were presented and discussed. The final paper of the afternoon was given by **James Whitehouse** (Open University). He described an investigation into the effect that the wall material has on the structural vibrations excited when lip-reed instruments are blown. Measurements of the wall vibrations excited when five different post horns were artificially blown were presented. The differences in the amplitudes of these wall vibrations were correlated with differences in the structural responses of the five instruments.

Acknowledgements

Thanks are offered to all session chairmen for their efforts in keeping speakers within the required timeframe, for conducting the question-and-answer opportunities that followed each paper, and for providing their words of wisdom for incorporation into this report. The efforts of the organising committee (Keith Attenborough, Anne Carey, Philip Dunbavin, Tim Leighton, Any Moorhouse and Bridget Shield) and the support of Jian Kang, Victor Krylov, Yiu Wai Lam, David Sharp and Eleanor Stride, who encouraged the submission of papers and, with the organising committee, reviewed the abstracts, are gratefully acknowledged. In their turn the organising committee wishes to record its gratitude to Linda Canty (IOA) and Sue Brindle (ISVR) for secretarial support, to Roy Bratby in his role as Chief Executive, and to Paul Fox for directing the audio-visual support at the Conference.

Thanks are also due to IAC for providing the prize draw champagne, and to NPL for paying for the steel band.

Finally, Tim Leighton, chairman of the organising committee, wishes to add his particular thanks for the generosity of the President and Council of the Institute of Acoustics in supporting this conference to an unprecedented extent, thus ensuring that attendance at it would be affordable to the young acousticians and students for whose benefit Bridget Shield first suggested holding the event.

Evening events and entertainment

This conference saw the end of an era as Roy Bratby finally handed over the reins to Kevin Macan-Lind. The Conference Dinner on this occasion consisted of a Caribbean Buffet, complete with the steel band 'Sounds of Steel' (courtesy of NPL), and demonstrating some more 'interesting' restaurant acoustics in the paucity of Sabine absorption in a large room. After the jerked chicken and spicy casserole the (also outgoing) President, Tony Jones, spoke appreciatively about Roy's nine years at the helm of the IOA.

Roy joined the Institute in June 1997, bringing his experience in general management, responsibility for strategic, financial and marketing policies in manufacturing industry and estate, property and charity management. Since his appointment, he had worked tirelessly on behalf of the Institute, and throughout demonstrated his excellent management abilities and commanded the respect and loyalty of the head office staff. He had earned the high regard of all the Institute's committees, and of the membership at large. Our headquarters operation had increasingly become the envy of our European sister societies. In short, Roy had been responsible for ensuring that the Institute attained the highest level of professionalism in the conduct of everything we strove to do.

He left the Institute in very fine shape. Sustained demand for its services together with excellent fiscal management now allowed an even greater focus on the ongoing strategy for shaping the Institute's future, including further progress towards a raised profile, increased influence, better engagement with younger members, enhanced membership services and improved headquarters resources.

So, to record the Institute's appreciation for Roy's diligence and professionalism in the way he had managed and represented the organisation, the president asked Roy to accept a token of the esteem in which he was held.

After the formalities of the dinner were complete, **Trevor Cox** (Salford University) presented to a packed audience a version of his presentation 'Communicating acoustics in a popular way' aimed at younger people, with a view to stimulating their interest in science in general and acoustics in particular. Despite recent attention from the surgeon's knife Trevor was as enthusiastic and manic as ever. He began by demonstrating the manufacture of a radish clarinet (as previously reported in Acoustics Bulletin) and explaining some of the principles behind single-reed instruments. In time–honoured fashion (and because the really big Japanese radishes were not yet quite in season) he fell back onto the one he prepared earlier, but although the barrel of the instrument was not new, the mouthpiece was cut and adjusted before the audience's very eyes. The whoopee cushion is another such instrument, depending as it does on the Bernouilli effect to produce a sound by allowing a flow of air to set a membrane (or reed) into vibration.

After a demonstration of the Bernouilli effect using a garden leaf blower and a toilet roll, we were treated to a demonstration of shattering a wine glass using high-intensity sound. Unfortunately, there was no tame opera singer to help, but a compression driver and some impressive high-speed video from the laboratory showed just how the glass behaved before it finally let go. Despite the presence in the third row of the Southampton University Health and Safety Manager, the demonstration was allowed to proceed and the glass fragments only reached the second row back!

After a brief recital on the musical whoopee cushions, Trevor returned to Bernouilli and conducted a performance played by a drainpipe quintet, each instrument consisting of a tuned length of pipe with a vibrating membrane stretched across it.

The audience was given the answer to the vital question 'How many 2mm holes can be drilled in a CD before it ceases to play?' - only four, actually. We were then treated to a demonstration of the 'confusaphone' with the aid of a cuddly toy, which showed - with the invaluable assistance of Claudia Fritz - how we binaural humans have evolved the detection of sound sources. Knowing the direction from which a sound was coming was a clear survival advantage! Although I suspect he had not exhausted his repertoire of acoustical tricks and treats, after more than an hour of this it was time for Trevor to collect up the props (mainly borrowed from his children). Perhaps the Conference delegates should offer their grateful thanks to the little Coxes too.

Towards the close of the Tuesday proceedings, the draw took place for a bottle of champagne kindly provided by IAC. The lucky winner was Philip Rossiter (Pell Frischman, Exeter).

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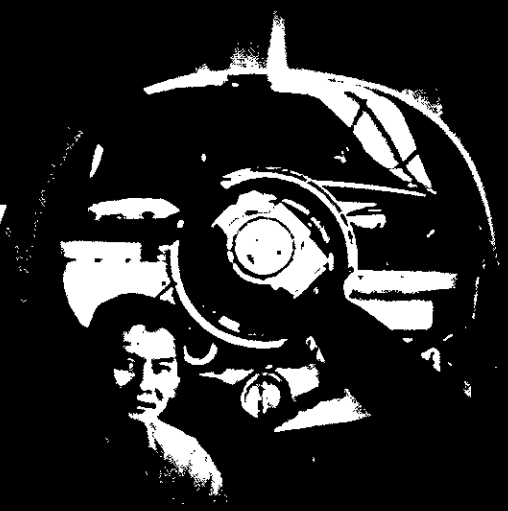

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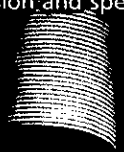

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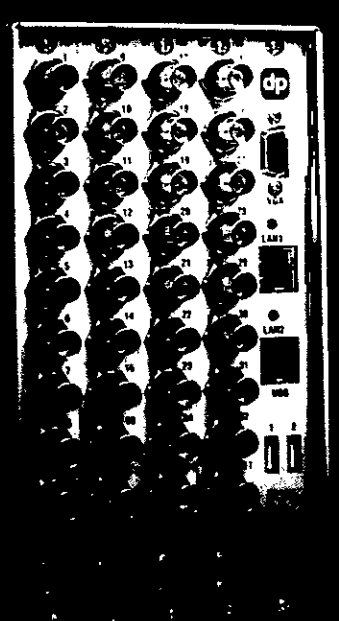

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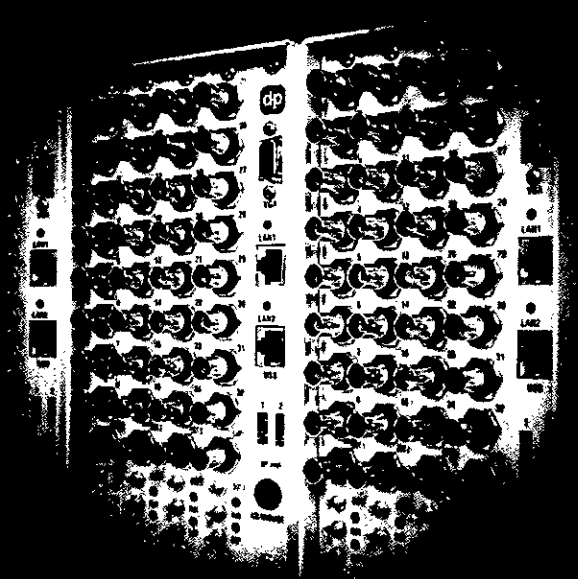

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Reducing Impact Sound

Paul Absolon.

Approved Document E (AD-E) of the Building Regulations 2000 has led to unprecedented attention being paid to the subject of acoustics in residential buildings. Impact sound in particular can represent a considerable challenge in this area, causing a real headache for some.

Understanding the requirements of the regulations is only half the battle. There is a need to source the correct acoustic materials and deliver a high quality of installation if compliance is to be secured. It seems that the route to AD-E compliance inevitably involves a complex journey beginning with a key decision - should Robust Details (RD) be adopted, or should the finished building be presented for pre-completion testing (PCT) instead?

This article explores some of the issues surrounding RD and PCT, and asks 'what happens if you fail?'. An analysis of the properties of some acoustical products is made in the context of impact sound transmission. Finally, a technical review is provided of the first approved acoustic tiling system (UK Tiling Association), which offers the construction industry an effective impact sound solution for a ceramic floor finish.

Pre-completion Testing and Robust Details

The number of variables involved in determining the acoustic performance of a building means that achieving compliance is far from straightforward, and the challenge was intensified by the confusion surrounding Part E criteria. Developers are often unsure whether to proceed down the route of registration of the project for Robust Details, and selecting RD products and designs, or waiting for PCT. Stories of failed site tests, including sites *with* RD-listed products, mean that there is no guaranteed route to compliance.

PCT is generally used where developers do not wish to follow the protocol involved in Robust Details. The increased cost associated with RD constructions is a disincentive to that route, given that a plot registration fee must be paid prior to undertaking the build. Further costs may also be incurred during the installation process.

Many builders have developed their own working practices which may not fit with the required processes of the Robust Details. Their reluctance to change their approach may be attributed to the time and cost implications imposed by further training, but equally, builders simply may not wish to change the working patterns of a lifetime.

Whilst Robust Details offer a valid alternative to pre-completion tests in terms of achieving compliance, the performance of any system is only as robust as its installation. This in itself presents a plethora of potential difficulties, which is why Robust Details Ltd and the National Home-Builders Council (NHBC) initiated random testing on RD-compliant sites. This quality control process is intended to increase the reliability of workmanship and the very 'robustness' of the approach.

In contrast, the benefit of PCT is that the developers' confidence is increased in the quality of the installation and the performance of acoustical materials. Unlike RD, which is only subject to random testing, PCT requires representative samples of floors and walls to be tested in the field to ensure compliance with AD-E. Test areas within a single project are randomly selected, which enables the workmanship to be controlled more effectively. Pre-tests are often carried out at the earliest possible stage.

The nature of PCT allows greater freedom in the implementation of a project. There is no specification as to which materials must be used, and no strict installation guidelines to be followed. Developers are able to make their own selections based on experience.

Impact sound transmission can be a particular challenge

In general, using PCT rather than RD gives a saving in costs, but a developer must weigh up the individual circumstances and requirements of a project, as this may dictate the most appropriate route to compliance. Although registering plots for RD is relatively expensive, developers must decide whether PCT might be more cost-effective than registration. Commercial considerations are always important when deciding which route to take, and in certain instances such as a small-scale apartment development, RD would often be more cost-effective.

However, the fact still remains that the quality of the installation is of the greatest importance to the acoustic performance of a development. In spite of this, numerous instances of failures continue to occur, and the failures are often the results of errors which could be easily avoided.

It is clear that there is a need to plan the acoustic provision of a project from the outset, and ensure that the nature and interaction of the variables involved are taken into account.

Developers should be aware of the acoustical implications of construction features that affect the performance of apparently well-insulated partitioning products, and ensure that any acoustic solution is correctly installed according to the manufacturers' guidelines.

Construction considerations

Among the factors that can compromise the performance of acoustic insulation is the incorrect installation of edge details. For example, if the bridge between the skirting board and a floating floor is not correctly fitted, flanking (or sound leakage) will occur.

Another cause of sound leakage is when down-lighters are fitted in ceilings beneath timber floors without any insulation provision. This can be controlled by providing acoustic, fire-rated capping at the back of lights.

Revisions to other parts of the Building Regulations (such as Part L) suggest a likely shift towards timber constructions, which exhibit a greater level of thermal insulation but a lower level of natural sound insulation than masonry. Whilst timber frame developments have their own RDs, incorrect installations might mean that the blockwork is too light, resulting in sound passing around the edges of a floor.

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Reducing Impact Sound - *continued from page 25*

Specific acoustic expertise is needed on projects using timber frame constructions.

Another construction type which needs careful consideration is the timber party floor when combined with a masonry wall. This structure tends to fail because of poor isolation, and high-performance sound isolating material can and should be installed to prevent the problem.

Screed isolation

An acoustic flooring system consists of several components, which means that correct installation is vital to performance. In the first instance, overlapping joints (as opposed to butt joints) are preferable, as this method increases the robustness of the system. When undertaking the installation it is essential that the joints are also taped. A common error when isolating the screed is a failure to turn up the acoustic material at the perimeter edge. A definite perimeter edge is required to ensure that the screed has no physical contact with the block work or party wall.

The cell structure of acoustic materials varies from one product to another, and some are naturally more porous than others. The best practice is usually to lay a protective membrane across the entire area, which will prevent screed penetration. The compatibility of acoustic products with screed types also needs to be considered. Certain acoustic materials may be compatible with a sand and cement screed, but could be the cause of a failure when a construction with a free-flowing screed is subjected to an on-site sound insulation test.

Unless advice is sought from an independent acoustic consultant at a project's outset, developers are likely to find themselves calling in the experts to troubleshoot part-way through a project, risking setbacks to time scales and budget overruns.

Knowing which acoustic precautions to take with a particular type of development is not sufficient to ensure compliance with the Building Regulations. Very often the performance of an acoustic product is depends on the quality of its installation. Some products are easier to install than others, but in all cases, unless installation guidelines are adhered to, the acoustic performance may be compromised.

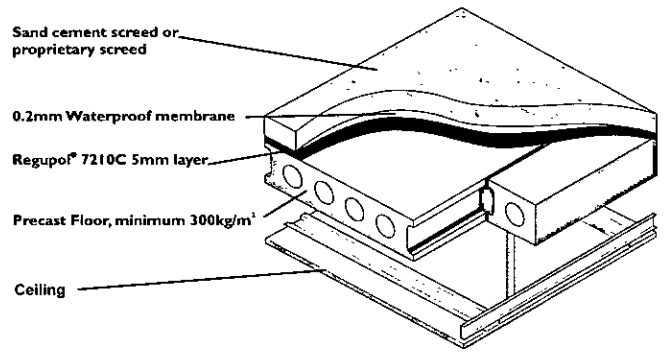
Where possible, only fully-qualified installers who are approved by the manufacturers should be employed. The key is to seek advice as early in a project as is feasible. This will help avoid specification errors or incorrect installation, and thus keep costs to a minimum.

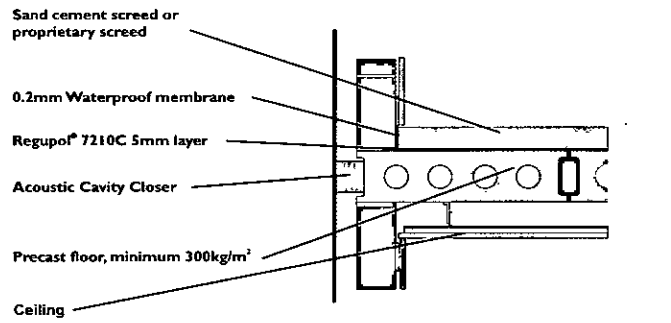
RD systems are less likely to suffer as a result of a substandard installation because many of the construction designs are detailed in a simple form, following extensive technical assessment. In spite of this, the overall performance of the system is reliant on workmanship, which means quality control processes must be in place to ensure the guidelines are being followed.

Installation quality control ultimately rests with the developer, and the site manager should be responsible for carrying out a first stage fitting check to ensure that correct installation procedures are being followed. Whilst working with a qualified installation team is recommended, comprehensive installation guidelines should also be provided as standard with acoustic materials. Without detailed guidance, errors may not be found until the testing stage, particularly with the installation of under screed products.

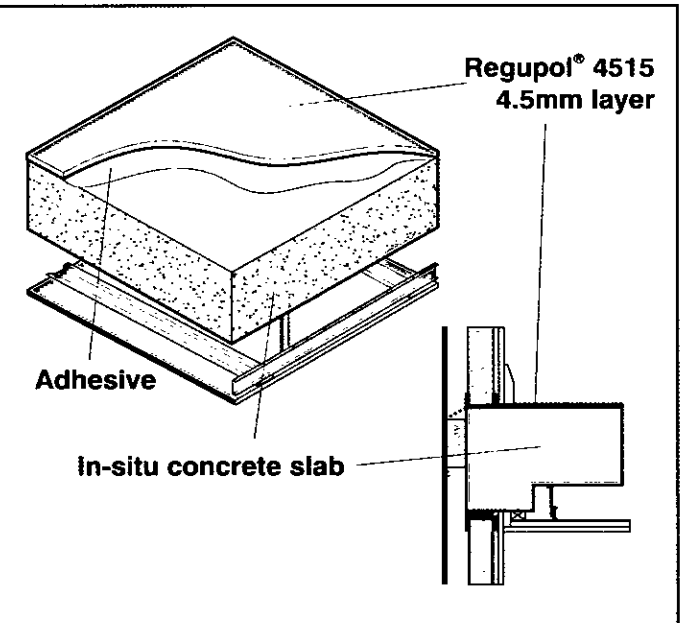
What happens after a failure?

Whether the RD or PCT route was adopted, once tests identify that the required acoustic standards are not met, the outcome for the project will be the same - failure. It can be an expensive failure. Not only must the cost of the original test be paid, but the subsequent course of action is dictated by the need to rectify the failure in as short a time as possible.





Typical build-up for a precast concrete floor



Typical build-up for an in-situ concrete slab floor

In the event of a failure, time is of the utmost importance. The knock-on implication is that purchasers' moving dates can be delayed. If a loan has been taken to fund the development, another month's interest will be incurred should the Council of Mortgage Lenders' completion date be pushed back as well.

Further work on the project will be required. This has a cost impact in terms of labour and materials, as well as time. Roughly one week per plot may be added on to a development, depending on the remedial work required. Generally this involves treating a ceiling rather than the floor.

Putting it right

When dealing with deficiencies of both airborne and impact sound, treating the ceiling is usually the less disruptive option. Increasing the floor height, which would otherwise be required, involves:

- The adjustment of the interface with the stairs, which is often impractical;
- Removing and replacing skirting boards;
- Trimming the bottoms of doors;
- The possible removal and replacement of internal partitions

If the floor fails on impact sound transmission, the ceiling can be re-hung using resilient hangers. If the problem is detected early in a project, floor treatments can be used to rectify the impact performance. However, whatever the course of action required for remedial work, the outcome for the developer is not positive.

Case studies

1 Acoustic underlays for refurbishment

When undertaking the refurbishment of St Paul's Church, Wigan, Annona Development had several considerations to take into account, apart from achieving AD-E compliance. Having chosen the PCT route because of the size of the development, Annona required a cost-effective material that would not waste valuable conversion space, and allow any type of floor finish to be used.

With plans to create 19 high-quality apartments within the former church, tackling the issue of impact sound was a priority. This is true of all refurbishment developments, but is particularly so with apartments. The inner structure of a building is often completely changed, meaning that the acoustical implications must be considered carefully at a very early stage.

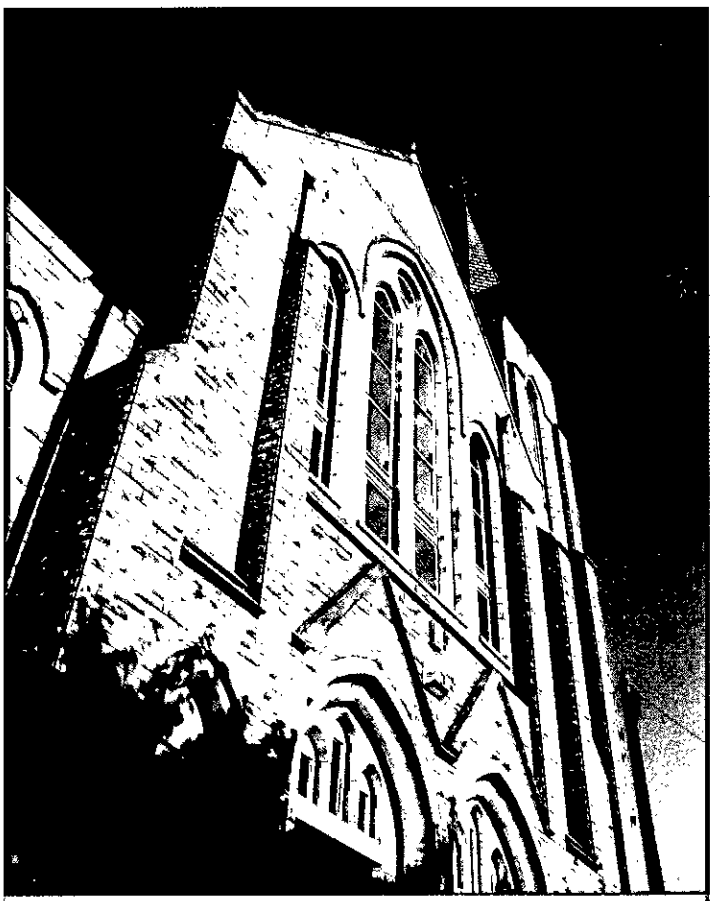
Having previously undertaken a refurbishment project to convert a Victorian property into separate living spaces, Annona Development was familiar with Regupol 4515, an acoustic underlay material designed to attenuate impact sound at source. It is an environmentally friendly over-screed material that can be bonded to all types of base floors, and is suitable for use with all types of floor finish, including ceramic tiles, vinyl, wood, laminates and carpet. Moreover, at only 4.5mm thick, the material helps to reduce construction heights. This was particularly important for Annona as the refurbishment of St Paul's included reworking two floors and introducing a new third floor.

On-site testing after construction showed that the impact sound levels specified by AD-E had been achieved by an average margin of 8dB in all rooms. Throughout the development, impact sound transmission levels were around 56dB $L'_{nT,w}$. Airborne sound insulation values of approximately 54dB $D_{nT,w} + C_{tr}$ were achieved.

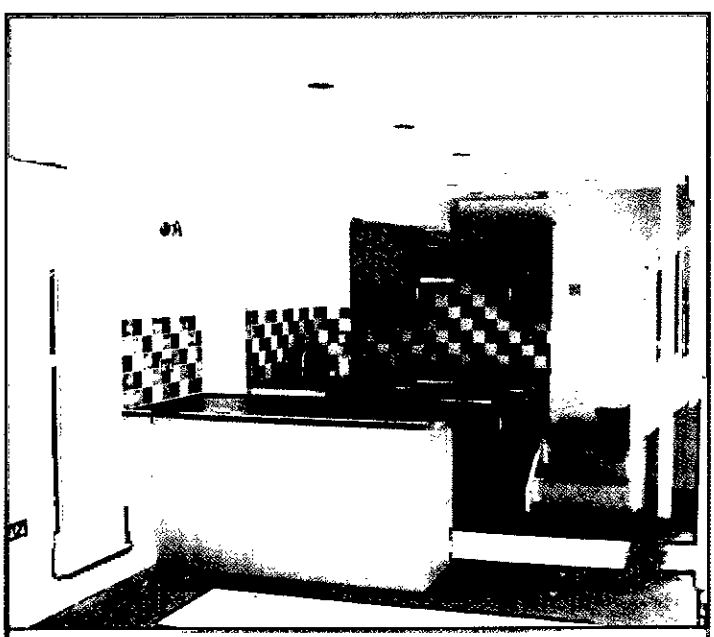
2 Under-screed for new build

Countryside Properties' Northern Division raised an incompatibility issue with a specific acoustic material two floors into its Sportcity development. Having opted for pre-completion testing, there was still time to seek an alternative solution before the agreed test date.

It was found that the original material was better suited to a sand and cement screed than to the free-flowing screed actually installed. The replacement material selected was Regupol 7210C, manufactured from recycled rubber and designed for new-build projects. The pre-completion tests showed pass margins of 11dB (airborne insulation) and 15dB (impact transmission). On the back of this performance, Countryside Properties has now implemented the same approach throughout the division.



Exterior of St Paul's Church, Wigan



Interior of St Paul's Church, Wigan

Tiling system for compliance

The issue of acoustic compliance has impacted greatly on the use of hard floor finishes, with developers being cautious about using a surface which possesses no natural sound insulation properties. Ceramics have particularly suffered as a result, leading the UK Tiling Association to establish a technical working group to prepare a paper on achieving

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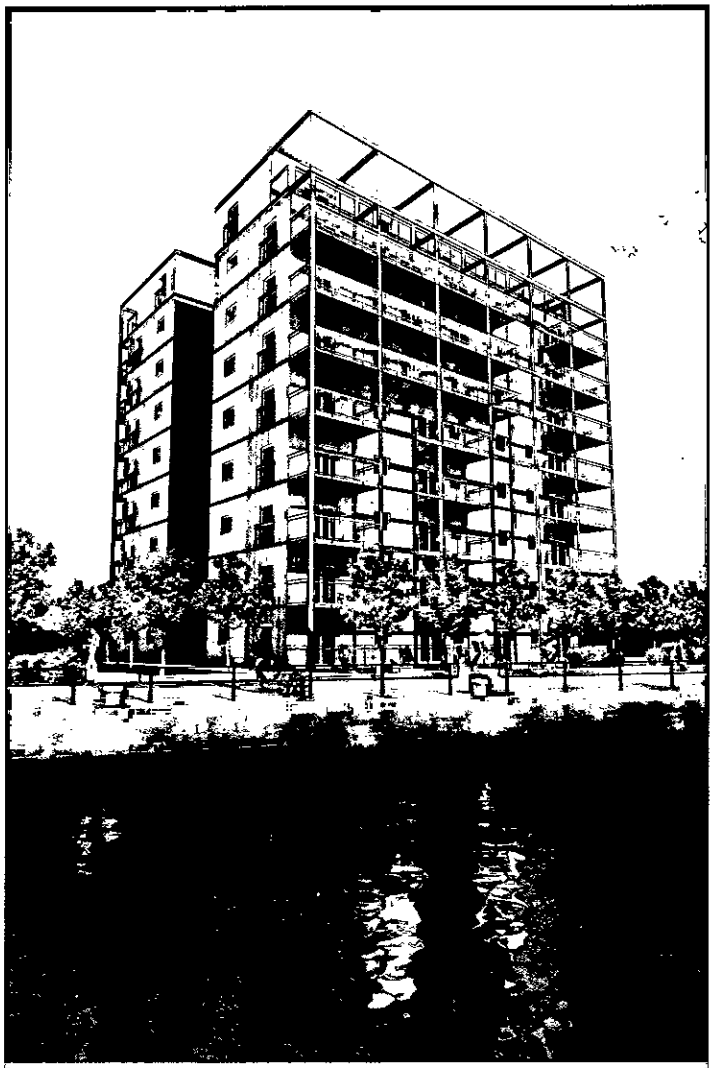
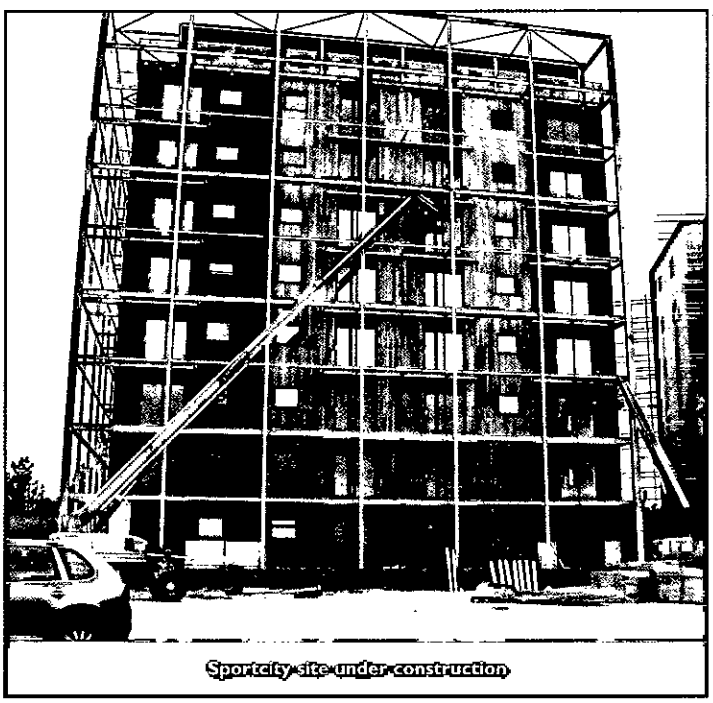


An artists impression of the Sportcity site



Sportcity site under construction

AD-E compliance with a tiled surface. Their findings appear in the document 'Ceramic and stone floor tiling to acoustic systems to meet the requirements of the Building Regulations 2000 Approved Document E'. It says that any tiling system should be sufficiently robust to withstand normal static, dynamic and impact loading. To be effective, any system should reduce sound transmission by at least 17dB on concrete floors, resulting in impact levels less than 62dB for a purpose-built dwelling and less than 64dB for a dwelling formed by material change of use.

The research paper used the coefficient of restitution, which assesses the impact resistance of ceramic floor tiling, to identify an acceptable acoustic performance level. The coefficient of restitution is determined by dropping a 19mm diameter 28g steel ball from a height of one metre, and measuring the rebound of the ball.

The research resulted in the following recommendations with regard to the installation of a ceramic surface finish where AD-E regulations applies.

- Where ceramic tiles are installed on resilient acoustic materials a minimum coefficient of restitution of 0.55 should be achieved;
- The tensile adhesive strength tested on an EN standard slab should be $0.5Nm^{-1}$;
- The weighted reduction of impact sound pressure (ΔL_w) should be at least 19dB.

Following the publication of these guidelines, the first acoustic tiling system to perform and achieve approval from the UK Tiling Association has been launched by BSW UK and Building Adhesives Ltd.

The main component in the ceramic impact reduction system is Regupol 4515, which is first bonded to the construction's base floor using Ardex AF200. Tiles are then laid on top of the resilient layer using the newly developed Acousti-Bond adhesive. The acoustic tiling system is completed by filling in the joints using an appropriate grout finish. The system has undergone independent testing and is always supplied with a method statement to ensure developers operate within the approved installation detail.

The site trials were undertaken at Trinity One, Leeds, with an independent acoustic consultant being commissioned to conduct the tests. A kitchen-to-kitchen test was carried out on the following construction:

- 8mm ceramic tiles on 4.5mm Regupol 4515;
- Adhesive on 160mm concrete / metal deck floor;
- 275mm void;
- 1 layer 15mm thick British Gypsum SoundBloc plasterboard

A bathroom-to-bathroom test was carried out on the following construction:

- 8mm ceramic tiles on 4.5mm Regupol 4515;
- Adhesive on 160mm concrete / metal deck floor;
- 275mm void;
- 1 layer 15mm thick British Gypsum SoundBloc plasterboard

The standardised impact sound pressure level $L'_{nT,w}$ for the kitchen-to-kitchen test floor was 57dB. The standardised impact sound pressure level $L'_{nT,w}$ for the bathroom-to-bathroom floor was 52dB. Both results were significantly lower than the allowed maximum of 62dB.

Impact sound: future considerations

Since the current AD-E came into effect, acoustical provision has improved greatly, and will no doubt continue to do so. The standards have been set, but with regular revisions to the required performance levels and the introduction of new guidelines, the acoustic materials industry must continue research and development into delivering high performance solutions that meet the needs of an acoustically demanding era.

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Aircraft Noise: Annoyance, House Prices and Valuation

Peter Brooker FIOA. **Cranfield University**

Introduction

"Nobody wants to buy your house. It's the aircraft noise. You'll have to reduce the price a lot."

Aircraft noise around airports causes annoyance, and tends to reduce the price of affected properties. Can annoyance be 'costed' by examining house price reductions? Are there other ways of valuing annoyance in monetary terms? This article summarises key research results and poses some questions.

Background

A previous article (Acoustics Bulletin vol.29 no.3, May/June 2004) reviewed UK Government sponsored studies to determine what index should be used to assess aircraft noise disturbance near major airports. This Aircraft Noise Index Study (ANIS) included extensive social surveys and noise measurements around these airports, plus detailed statistical analyses. The main result of the study was that L_{eq} (A-weighted) would be an appropriate index, and government made the decision to use the 16-hour L_{eq} for the UK aircraft noise index.

But people's expressed annoyance is not the only way of assessing the impact of aircraft noise. Increasingly, research studies and government policy have tried to evaluate in financial terms the disturbance caused by noise. Current UK Government policy states (DfT, 2003):

"...we will work to ensure that aviation meets its external costs, including its environmental and health costs. The aviation industry has a responsibility to reduce its impacts under the 'polluter pays' principle."

Valuation of aircraft noise's external costs is a vital component of environmental impact assessment. If, say, Heathrow airport's runways are operated differently, or if new runways are built, then what are the corresponding environmental costs? What are aviation 'external costs' for noise disturbance? Very accessible general guides to environmental economics are the King and Mazzotta web site (2006) and the early chapters of Bateman et al (2001).

Environmental economics starts with the concept of 'human well-being'. Environmental costs decrease this well-being. They usually occur because the activities of firms and individuals affect third parties. Airlines flying people from airports produce aircraft noise, which disturbs nearby residents, ie reduces their well-being. But these residents generally do not have what are termed 'property rights': they do not own some specific level of peace and quiet; and they cannot take legal action against the airport, the airlines, the passengers, the local planning body that permitted the airport to be built, or the Government. These particular property rights were removed under various UK civil aviation acts during the last century.

The absence of these property rights means the absence of a direct commercial market for peace and quiet, so how can costs be estimated? Economists have developed ways of inferring these costs by indirect means (see HM Treasury, 2003). Figure 1 compares some of these methods with measurement of annoyance and gives some aircraft noise examples. Some context is needed to understand the information. Well-being is determined by the kinds of things that people prefer, with a dislike corresponding to a negative preference. There are two basic ways of measuring preferences. Preferences are revealed either through actual choices and market behaviour, or are stated through questionnaire (market research) procedures. Quantitative measurement of a preference is found from the individual's willingness to pay (WTP) for the avoidance of a cost, or willingness to accept compensation for tolerating a cost.

Method	General Description	Aircraft Noise Example
Annoyance (or Disturbance)	Ask people directly, in a survey, how much aircraft noises disturbs them and/or how much they are annoyed at their activities being disturbed	How much does aircraft noise bother or annoy you: Very much? Moderately? A little? Not at all? (eg Brooker, 2004)
Hedonic Pricing HP (Revealed Preference RP)	People may be willing to live in an area that is subject to aircraft noise, but only if they receive a discount on the price. The size of the discount measures their aversion to aircraft noise exposure.	How much did they pay for their house and when? How many bedrooms and/or bathrooms, how far from the airport, how big is the garden, etc (eg Cohen and Coughlin, 2005).
Contingent Valuation CV (Stated Preference SP)	Ask people, in a survey, how much they would be willing to pay for an aircraft noise environment; or the amount of compensation they would be willing to accept to give it up. Thus, WTP is *contingent* on a specific hypothetical scenario.	What would you pay for this kind of house in any area with no noise; and then how much if there was frequent aircraft noise; and then how much if there was severe noise? (eg Feitelson *et al*, 1996)
Contingent Choice CC (Stated Preference SP)	Like contingent valuation, it asks people to make valuation choices based on a hypothetical scenario, but it does not ask people to state their values directly. Values are inferred from the hypothetical choices or trade-offs.	An individual currently facing 10 daytime flights per hour, 6 evening flights per hour and paying 20? per week in tax, is asked to state a preference and second preference from: a reduction in daytime flights of 2 per hour; a reduction in evening flights of 2 per hour; and a 2€ per week reduction in tax (eg Bristow and Wardman, 2003)

Figure 1. Comparison of annoyance and preference measures

For aircraft noise, the most important Revealed Preference method is known as 'Hedonic Pricing', while the two common Stated Preference (SP, or WTP) techniques are known as Contingent Valuation and Contingent Choice, as shown in Figure 1. It is important to note that the results of all of these methods must match the responses of large numbers of representative individuals exposed to aircraft noise. The results from the research literature are examined in turn.

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Aircraft Noise - *continued from page 29*

Hedonic Pricing

The name Hedonic Pricing (HP) is an unfortunate product of economists' liking for Greek words. Hedonic is the adjective from hedonism, 'pleasure', and merely refers to people wanting to make decisions that deliver the most pleasure taken as a whole. The decision of most relevance to aircraft noise is that of buying a home near - or not near - an airport. All other things being equal, houses tend to cost less near airports, and the major reason for this is that most people prefer quiet environments to noisy ones - a revealed preference. These are obvious statements, but turning the obvious into something quantitatively useful has led to a considerable body of research work.

The earliest HP research that successfully combined theoretical economics and empirical data about property was Walters (1975). Since then, there have been dozens of HP studies on the effect of airports on property prices, but the basic methodology proposed by Walters is still in place. The empirical model is:

$\text{Log}\, V = A_0 + A_1 (\log \mathbf{Z}) + A_2 L_{eq}^* + U$

Here:

V = house price

Z = vector of house factors, eg size, quality of area

L_{eq}^* = Noise index, generally Leq-based, measured in dB

A_0, A_1, A_2 = constants to be determined by multiple regression fitting

U = error term, assumed to vary 'randomly'

Some economic researchers incorrectly say that L_{eq}^* 'is' annoyance, rather than being a metric used to measure annoyance. The key result from statistical analyses is the value of A_2. Multiplied by 100, it is the Noise Sensitivity Depreciation Index (NSDI):

NSDI = percentage decrease in property price / increase in Leq* value

Thus, if the NSDI is 1%, a property exposed to 65dB L_{eq}^* sells for 10% less than the same property exposed to 55dB L_{eq}^*.

There have been dozens of studies to estimate NSDI values for particular airports, published in journals of economics, (real) estate finance, banking and urban studies. Most studies are for the USA, Canada and Australia. Recent review articles are by Schipper *et al* (1998), Navrud (2004 - work initially reported in 2002), and the most recent by Nelson (2004). These are complex statistical exercises, given the need to control for several effects, in particular the positive house price effects of accessibility to an airport and its employment opportunities (for examples see Tomkins *et al*, 1998). Nelson estimates a weighted-mean NSDI of 0.58% per decibel for pooled USA and Canadian data, using L_{dn} as the noise index.

More recent American and Canadian work than the studies in Nelson's data set, eg Cohen and Coughlin (2005), McMillen (2004), Gillen (2004), is generally consistent with these values. There is also some interesting work on Amsterdam airport by van Praag and Baarsma (2005), which is discussed later. Typically, 55dB L_{dn} is used as the lower cut-off value for aircraft noise effects, although there is considerable debate about this (eg see Navrud, 2004).

There has been limited UK HP work on airport effects, but the NSDI values are similar to Nelson's statistical estimates, eg Gautrin (1975) gave 0.62 for London Heathrow; Pennington *et al* (1990) 0.47 for Manchester; Tomkins *et al* (1998) 0.78 for Manchester. In some studies, aircraft noise was a component of a mainly road traffic environment (Bateman *et al*, 2001).

Stated Preference

In contrast to HP studies, there are few SP studies on aircraft noise. There is not agreement on methodology, so some effort is required to put the results into some common form. Navrud (2004) critically reviewed European SP studies published up to 2002, but found just two of reasonable quality that used an L_{eq}^* base. Pommerehne's 1988 study at Basel, Switzerland produced a 43€ WTP/dB/hh/year. Thune-Larsen 1995 work at Oslo Airport Fornebu, Norway produced a 190 - 959 €WTP/dB/hh/year. Here, WTP/dB/hh/year is 'willingness to pay (WTP) per decibel (dB) per household (hh) per year, reported in national currencies in the year of the study and converted to 2001-value euro.

Feitelson *et al* (1996) carried out SP studies near an undisclosed airport. The key question is shown in Figure 1. The house price effect was about four times that of a typical HP analysis. However, this was in the context of a major airport expansion, with a noise exposure of the order of 75dB L_{eq}. Since 2002, three other SP studies have been published: Bristow and Wardman *et al* (2003) at Manchester, Lyon and Bucharest; Carlsson et al (2004) at Stockholm]; and Van Praag and Baarsma (2005) at Amsterdam.

Bristow and Wardman *et al* (2003) studied three airports, in different countries, for the Eurocontrol Agency. The study is well documented, and they stress that this was very much exploratory work to test methodologies - for both CV and CC - and to find orders of magnitude. Three different types of stated preference experiment were used: embedding aircraft noise nuisance within a broader quality of life context; offering changes in aircraft movements by aircraft type within specific time periods; and offering changes in generic aircraft movements by time of day. Figure 1 shows an example of the kind of question used.

The main quantitative results concern the relative value of removing flights during different periods of the day. Table 1 shows this value for Manchester and Lyon (the Bucharest results are statistically uncertain), which corresponds to a change of one aircraft per hour for the time period in question. Thus, for example, respondents in Manchester would be prepared to pay 1.07€ per week to have one fewer aircraft per hour in the (12 hour) day period and 0.39? per week to have one fewer aircraft per hour in the (4 hour) evening period.

	Manchester	Lyon
daytime	1.07	0.90
evening	0.39	1.33

Table 1 Values (€) per aircraft per hour per period per week

Carlsson *et al* analyse the marginal WTP for changes in noise levels related to changes in the volume of flight movements at a city airport in Stockholm, Sweden, by using a choice experiment:

"When estimating marginal WTP for different times of the day and days of the week, we find that these vary with the temporal dimensions: mornings and evenings have higher marginal values... A large proportion of people are satisfied with the current level of flight operations at the airport and are not prepared to trade off any change for monetary compensation or payments."

This is consistent with the Bristow and Wardman results, shown in Figure 2 (for Manchester), which demonstrate the variety of reasons people give for not participating in a CV exercise. Unfortunately, Carlsson *et al*'s acoustics content is negligible - there is no analysis in terms of Leq or any other noise index - so it has little value for present purposes.

The study by van Praag and Baarsma (2005) into the effects of Amsterdam Schiphol airport introduces a novel method. It is not an SP technique, but as it relies on questionnaires rather than HP techniques, it is included as such. The authors say that a SP approach would have considerable difficulties, because it implies the risk of strategic behaviour, for example, people overestimating noise and/or boycotting surveys. Amsterdam airport's noise nuisance problems are quoted as 'hot issues' and a 'playing field for environmental activists'.

Van Praag and Baarsma use a survey questionnaire to find individuals' ordinal life satisfaction - or 'happiness' - measured on a 1 to 10 scale originally

Question: "Overall what is the most that you would be willing to pay in additional council tax PER WEEK to HALVE the overall number of flights"
In the daytime (*ie* every day)
In the evenings (*ie* every day)"

Response	daytime %	evening %
No answer	6.5	10.0
Zero	68.0	64.5
Willing to pay	25.5	25.5

Zero willingness to pay	%
Not bothered about aircraft and a reduction is not worth anything to me	28.3
I am bothered by aircraft, but believe the benefits of the airport outweigh the cost in terms of noise	13.0
I am bothered by aircraft, but do not believe that any changes would take place	26.1
I am bothered by aircraft, but not willing to pay because I have a right to a quiet environment	33.3
Other	2.9

Figure 2 Manchester CV questions - adapted from Bristow and Wardman (2003)

developed by Cantril. A person's answers depend on income, family size, age, exposure to aircraft noise and other variables. This data, analysed by a complex form of multiple regression produces, in essence, a best-fit equation explaining happiness as a function of income, noise and these other variables. It is then possible to estimate the change in income that would be necessary to compensate for a specified change in noise exposure.

The main van Praag and Baarsma result is that the net income compensation needed to neutralise an increase in noise from 20 to 35 Ku is about 3% of net annual household income or about 9% of housing costs. For a noise-insulated house, the compensation needed is much less, about one-third of that percentage. [20 and 35 Ku correspond approximately to 53 and 58 L_{den} respectively.]

Issues

The increasing use of valuation techniques opens some important questions.

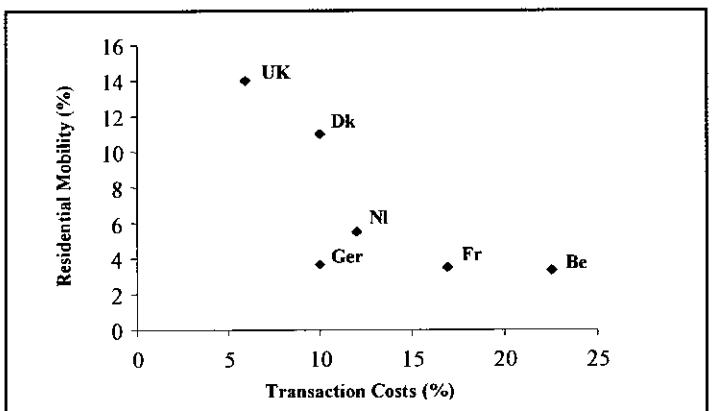

Figure 3 Residential mobility (%) and transaction costs (%) adapted from van Ommeren and van Leuvenstein (2003)

Do the techniques broadly do what they are intended to do? If so, are they accurate? Do they complement or conflict with annoyance results? A selection of these kinds of issues is discussed below.

Are HP studies concerned with aircraft noise annoyance?

There are some misunderstandings about HP studies for aircraft noise. Consider the parliamentary answer reported in Hansard from 17 July 2003:

"Property Prices (Heathrow Flight Path)

Mr McNulty: House prices around Heathrow vary and are affected by many factors, as elsewhere. Both the economic benefits of the airport and the environmental disbenefits will affect property prices in a wider area than under the flight paths. There is already extensive worldwide literature on the effect of aircraft noise on house prices although the literature largely concerns daytime noise and it is difficult to isolate aircraft noise (or any other single factor) as a discrete influence on house prices."

The reference to 'day time noise' misses the point. Most HP studies use L_{dn} or L_{den}, both of which contain a night-time component. House prices are affected by the total noise effects that people know about, including daytime/evening annoyance and perceived sleep disturbance. They may even encompass the possible effects of learning impairment at local schools - families do move house for better schools. But note also that house prices are affected by other airport-related issues, eg air pollution levels and the associated road traffic.

Do HP studies estimate somebody's 'well-being'?

The use of phrases such as 'well-being' and 'willingness to pay' do not spell out just whose beliefs and decisions are being examined. They are not those of the average person summed over time. There is comparatively high housing mobility in the UK, so people who are very perturbed by aircraft noise - those who find it 'unacceptable' - will tend to move away from high L_{eq} areas, to be replaced by people who are generally less perturbed, and who may indeed work at the airport. HP analyses will compare these kinds of people with 'average' or 'less perturbable' people living in much lower L_{eq} areas. The price

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differentials would therefore tend to underestimate the loss of well-being felt by a typical person in a low L_{eq} location exposed to much higher noise exposure.

Are SP CV studies accurate?

CV has been widely used for more than 20 years, but there is considerable controversy over whether it properly measures people's willingness to pay for environmental quality. King and Mazzotta (2006) list sixteen issues and limitations of CV (compared with four advantages), finishing with: "Many people, including jurists, policy-makers, economists, and others, do not believe the results of CV". This is mainly since SP surveys are hypothetical in both the payment for and provision of the good in question. This so-called hypothetical bias is reviewed in Murphy *et al* (2005), which suggests that the average bias is about 2.5 to 3 times greater than actual cash payments, but that this covers considerable variations.

Does annoyance 'equal' valuation?

If simultaneous Annoyance and SP Valuation exercises were to be carried out on the same people, would annoyance 'equal' valuation? Are they measuring the same thing? To reiterate, authors of valuation studies often say that their results are correlated with annoyance, but in practice they match valuation results against an indicator of annoyance - shown here as L_{eq}*. To pose two, more analytical, questions:

1. Are the core noise variables the same, ie is disturbance, however it is assessed, specified by some appropriate core function of weighted noise energies?
2. Is valuation directly proportional to or some kind of strictly monotonic transform of annoyance?

Valuation results specified in £, € or $ may tempt people into believing that valuation figures have somehow been demonstrated to have 'cardinal' properties, eg two individuals' one (SP) £ is equal to another individual's two £s (see discussion on Scale properties in Brooker, 2004 and Stevens, 1946).

Are valuation results from other countries applicable to the UK?

The Bristow and Wardman (2003) results already suggest that Manchester and Lyon have markedly different SP ratings for day and evening aircraft noise. Van Praag and Baarsma (2005) attempted to carry out a HP study for people living near Schiphol, but failed completely. They comment: "...house prices in the Greater Amsterdam area do not significantly depend on noise nuisance. Undoubtedly, this has to be explained by the chaotic situation in the Amsterdam housing market." This is diagnosed as the product of long-term housing shortages, government regulations and comparatively large transactional costs.

The Netherlands housing market is actually more typical of European countries than is the UK's. Figure 3 is from van Ommeren and van Leuvensteijn (2003): it shows on the vertical axis how frequently people move and on the horizontal axis the costs of housing transactions as a percentage of the property value. The high transaction costs in most of these countries imply that the economic assumptions necessary for HP calculations, eg Bateman **et al** (2001), will be largely absent.

Can SP CA results help to create better noise indices?

The European Commission endeavours to maintain a high reputation in environmental matters, but its introduction of L_{den} has not been supported by large-scale Europe-wide quantitative evidence. The major methodological problem in substantiating L_{den} is the intercorrelation between L_{eq} values in different time periods. Can CA help to provide support for L_{den} (or otherwise)? Some Bristow and Wardman (2003) results are developed to illustrate the idea.

L_{den} is a variant of L_{eq}. L_{den} adds an artificial extra number of decibels to aircraft noise levels occurring in the four-hour evening (5dB) and eight-hour night (10dB). In the following equation: ** denotes 'to the power of'; * is times; the i subscript denotes the i^{th} noise event; SEL_i is the noise energy in the i^{th} aircraft noise event adjusted so that it lasts for one second; d, e and n are day, evening and night; W_e = 5 and W_n = 10; and T is 24 (hours).

$$L_{den} = 10 \log \{ T^{-1} [\Sigma_{di} 12*10^{**}(SEL_{di}/10) + \Sigma_{ei} 4*10^{**}((SEL_{ei} + We)/10) + \Sigma_{ni} 8*10^{**}((SEL_{ni} + W_n)/10)]\}$$

Bristow and Wardman estimate the values to respondents of having one less aircraft per hour in the (twelve-hour) day period and having one less aircraft per hour in the (four-hour) evening period. What could these values say about day and evening weightings in noise indices? Suppose that SP CC and annoyance have the same core functional form in noise terms (which still allows for one being a transformed function of the other). For Manchester, Bristow and Wardman say that twelve fewer daytime aircraft are worth 1.07€ and four fewer evening aircraft are worth 0.39€, so one aircraft over the day period is priced at 1.07 / 12 = 0.089€, and one aircraft over the evening period is priced at 0.31 / 4 = 0.0775€. If the core functional forms are the same, ie sum the SEL values as in L_{den}, *and* if the respondents are judging day and evening aircraft to have the same average SEL value, then the ratio 0.0775 / 0.0725 = 1.069 should equal 10^(W_e/10). This gives the evening weighting W_e = 10 log 1.069 = 0.3dB for Manchester. In contrast, the Lyon results give W_e = 10 log 3.44 = 5.4dB. The Manchester 0.3dB and Lyon 5.4dB values compare with L_{den}'s (European) 5 dB weighting.

Conclusions

Valuation techniques are a useful complement to annoyance measurements. However, the apparent precision of £, € and $ numbers can obscure the statistical modelling, economic and psychological assumptions that are being made. Contingent choice methods may be helpful in providing some quantitative basis for evening and night weightings.

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Audio Power Amplifiers: A Brief History

Gerald Stanley & Jim Stembel.

Introduction

The twentieth century produced a number of significant electron device inventions which in turn shaped the circuit inventions which have defined the audio power amplifier as we have known it. We now begin the next century of audio power amplifier design with new devices and new challenges. Despite all the change, the customer's desire for efficiency, value and reduced size are unending themes in the ongoing revolution. Balanced Current Amplifiers (Class I) are enabling new generations of high-voltage direct-coupled designs that can drive 100+ volts rms without requiring a bridged output stage. This brief article reviews the evolution of the audio power amplifier from its origins.

How did we get here? (Today' technology)

History

Even before the first Thermionic emission in 1873, men have quested in experimenting and discovering, looking for ways to improve life and the comfort therein. People today have no less desire and drive to do the same. While many fields of science exist, many significant discoveries and inventions are burned into history, even to the non-scientific person. Examples are items such as Edison with the electric lamp, and Bell with his telephone. Between these monumental discoveries are many more, which while not as well known, are no less significant. The audio industry, especially the power amplifier, is no different. There have been many significant discoveries and inventions which have moved audio quality to the point we are at today. While new technologies are emerging, driven by audio electronics manufacturers, it is very interesting

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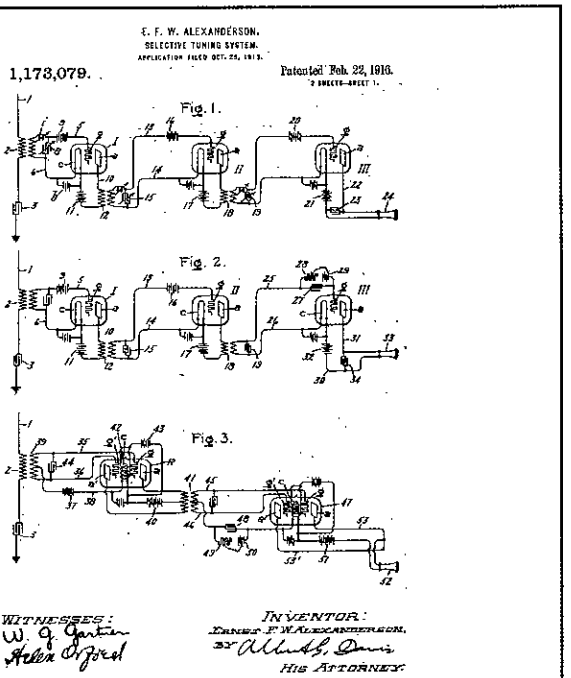

E. F. W. ALEXANDERSON.
SELECTIVE TUNING SYSTEM.
APPLICATION FILED OCT. 25, 1913.

1,173,079. Patented Feb. 22, 1916.

2 SHEETS—SHEET 1.

Fig. 1.

Fig. 2.

Fig. 3.

WITNESSES:
W. G. Gaston
Helen Orford

INVENTOR:
ERNST F. W. ALEXANDERSON,
BY Albert G. Davis
HIS ATTORNEY.

Figure 1. Alexanderson's 1969 US patent: Class A amplifier

Audio Power Amplifiers: A Brief History - *continued from page 33*

to note how long many of the designs and patents had been in existence before they became commercially available. The latest of these is the BCA or Class I audio power amplifier.

Below are a few of the landmarks on the path.

1873	Thermionic emission	(Frederick Guthrie)
1906	First broadcast of speech	(Reginald A Fessenden)
1912	Vacuum tube amplifier	(H D Arnold and Irving Langmuir)
1912	Vacuum tube oscillator/regenerative receiver	(E H Armstrong)
1913	Push-pull class A amplifier	(E F W Alexanderson)
1918	Superheterodyne receiver	(E H Armstrong)
1926	Pentode	(Benjamin D H Tellegen)
1948	Transistor	(John Bardeen, Walter H Brattain, William B Shockley)
1954	Solid-state class D PWM amplifier	(R L Bright)
1971	Pentode	(Gerald Stanley)
1975	Junction temperature simulation	(Gerald Stanley)
1996	BCA (Class I, I is for interleave) PWM technology fielded	(Gerald Stanley)

Factors driving change: Amplifiers and electron devices

As with all technologies, the quest to fulfill market needs and desires has been the driving force of successful businesses choosing to offer technology to their markets. It is imperative that manufacturers learn to become more efficient in product manufacturing and product development. Mastering these skills sharpens a manufacturer to a market advantage. Today's evidence of this is product offerings that are better in quality, higher in performance, and lower in cost. An example is the original Crown DC300 amplifier at 150 Watts per channel, costing over US$700. Today, equal or better product can be purchased at prices as low as US$299. This is even more significant if 1967 dollars are compared with today's.

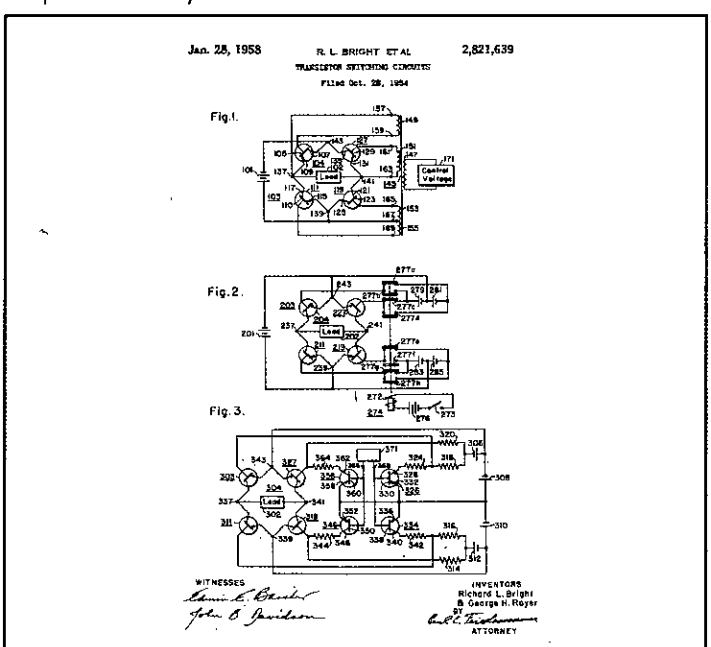


Figure 2. Bright's 1958 US patent: Class D amplifier

Factors resisting change

While we usually offer and discuss the positive attributes of our industry improvements and accomplishments, there are negative resistance issues opposing and slowing the progress of our change. Human nature itself is one of the most significant resistors of change. It is within our nature to do what we know and are comfortable with. This often restricts creative thinking of

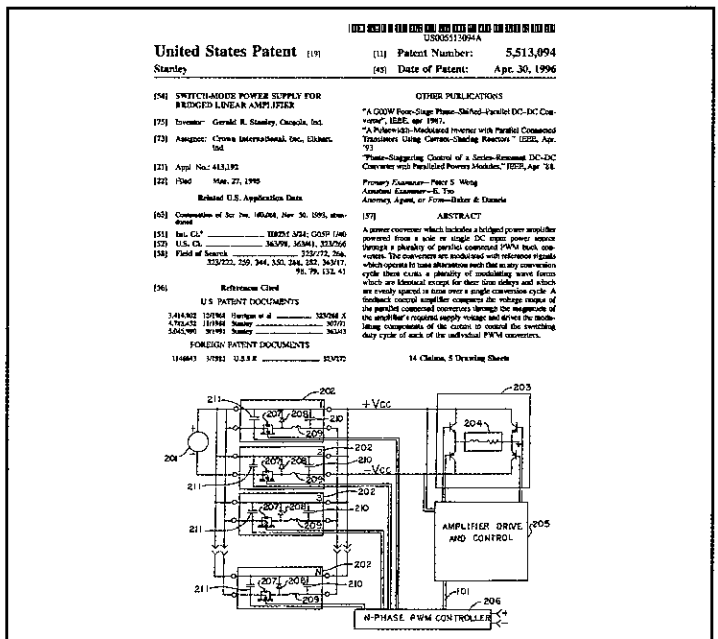


Figure 3. Stanley's 1996 US patent: Class I amplifier

"what could be". New technologies also require the retention of engineers. Of course this then leads to investments in new manufacturing processes and equipment. Above all, there is the fear of the unknown as well as failure. History has always shown that those with the greatest achievements were not afraid to risk the humiliation of failure.

Electron devices and technology today

As has always been the case with history, change is inevitable. As technology moves forward, it opens new opportunities for manufacturers to develop new methods and offer better solutions to their communities. Just as we found ourselves in the 1960's with the opportunity to transition from vacuum tubes to solid state transistors, we are now embarking on yet another technology leap that in itself is as significant as the opportunities we experienced in the 1960's. This exciting transition is just now in its infancy. While discussing power amplifiers, this technology will have a major impact on how loudspeakers are designed. With amplifier voltage capabilities now exceeding 200Vrms and higher voltages coming, loudspeaker designs can now change to improve performances and lower distortion barriers we face today. There are many new opportunities available for those who have yet to imagine them. The bi-polar junction transistor has served us well over the past decades as we now usher in the newt very efficient, generation of devices and amplifier designs with even more promise than in the past.

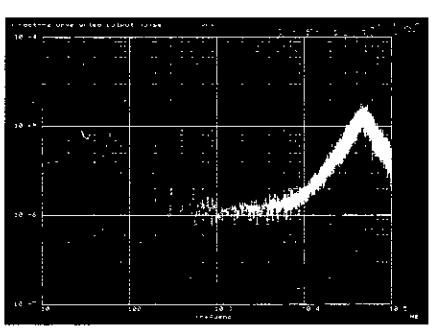


Figure 4. Typical frequency response of a Class I amplifier

This article is loosely based on a paper given by Jim Stembel at Reproduced Sound 21.

Gerald Stanley is Vice President, Research and Development, and Jim Stembel is International Business Development Manager, Product Development, both with Crown International inc.

Control of Noise at Work Regulations 2005

Ian Bennett CEng MIOA.

Ian Bennett reviews the new workplace noise legislation, comparing the provisions of the 2005 Regulations with those of their predecessors, the 1989 Regulations. Some remarks are included on the future of noise-induced deafness and similar civil claims.

The 2005 Regulations came into force, so far as the vast majority of employers are concerned, on 6 April 2006. For the first time there is specific reference to noise in the workplace in respect of the music and entertainment sectors in respect of which the Regulations will come into force on 6 April 2008.

The Regulations are far more comprehensive than their predecessors. Some of the more significant changes are set out below.

Regulation 4:
Exposure Limit Values and Action Values

The action levels have been renamed and have been lowered. The Lower Action Level (equivalent to the previous First Action Level) is now 80dB, being a daily personal noise exposure (LEP,d) of 80dB. 'A' weighting is implicit.

The Second Action Level has been replaced by an Upper Action Level of 85dB, and an Exposure Limit Value has been added at 87dB.

The 'Exposure Limit Value' is the level of daily (or weekly) personal noise exposure which must not be exceeded. When assessing against the Exposure Limit Value of 87dB, account is taken of the protection given to the employee by any personal hearing protectors provided by the employer. Hearing protection is disregarded when considering the Lower and Upper Exposure Action Values of 80 and 85 dB.

In other words, if the equivalent continuous sound levels in the workplace exceed either 80 or 85 dB before hearing protection is applied, duties on the employers are triggered, and steps must be taken to reduce the levels. However, when assessing the Exposure Limit Value, that is, determining whether or not an employee has actually been exposed to excessive noise, the protection afforded to that employee in the form of hearing protection is taken into account, and the effect of the protection on the actual exposure level is calculated.

Regulation 5:
Assessment to the Risk of Health & Safety Created by Exposure to Noise in the Workplace

In the 1989 Regulation 4, provision was made for a noise assessment to be carried out by a 'competent person' in order to identify employees likely to be exposed to excessive noise. Provision was made for that assessment to be reviewed in specific circumstances.

In the Control of Noise at Work Regulations 2005, further provision is made for the noise assessment to be 'suitable and sufficient'. The purpose of the assessment is also slightly different. The risk assessment must now identify the measures which need to be taken in order to meet the requirements of the Regulations, and the risk from that noise to the health and safety of those employees must be considered.

Moreover, the risk assessment is to be prepared in the light of:

- Observations of specific working practices;
- Reference to relevant information on the probable levels of noise corresponding to any equipment used in the particular working conditions (the assessment should take into account, and comment on, information provided by the manufacturers of work equipment and the availability of alternative equipment designed to reduce the emission of noise); and
- If necessary, measurement of the level of noise to which the employees are likely to be exposed.

Steelworks are notoriously noisy places

Further detailed guidance is given on what will be included in the risk assessment, none of which appeared in the 1989 Regulations. These were somewhat vague as to the required form of the assessment.

Another interesting feature of the new Regulations is that the assessment is supposed to comment on exposure to noise in rest facilities supervised by employers, and should also deal with appropriate information obtained following health surveillance including, where possible, published information and the availability of personal hearing protectors.

This assessment, as in the 1989 Regulations, should be kept under review. Whereas the older Regulations provided for the assessment to be reviewed only when there was a reason to suspect that it was no longer valid, or after there had been a significant change in the work to which it related, the new Regulations provide for risk assessments to be reviewed regularly. It is also noteworthy that the circumstances set out in the original Regulations for reviews of the assessment are now circumstances in which the new Regulations expect that re-assessment shall be performed 'forthwith'.

There was previously no duty on employers to consult employees and representatives on the assessment of risk. Such an obligation now exists under Regulation 5(5).

Regulation 6:
Elimination or Control of Exposure to Noise at the Workplace

Under Regulation 6 of the Noise at Work Regulations 1989 there was a duty upon an employer to reduce the risk of damage to the hearing of his employees from exposure to noise to the lowest level reasonably practicable. The new Regulations go further and oblige the employer to ensure that that risk is eliminated where possible. Guidance is given as to how such reductions and elimination of risks should be achieved.

At Regulation 6(2) mention is made of the implementation of a programme of organisational and technical measures (excluding the provision of hearing protection). Various examples are given such as: the implementation of other working methods; a choice of alternative work equipment; the design and layout of the workplace, workstations

Employers must provide hearing protection even if it is not requested by an employee

and rest facilities; and the provision of suitable and sufficient information and training for employees, so that work equipment is used correctly in order to minimise exposure to noise.

The obligations on the employers are further extended to include implementation of appropriate maintenance programmes for work equipment, the workplace, and workplace systems, and the limitation of duration and intensity of exposure to noise.

Employers must also consider how work schedules apply to employees in respect of their periods of exposure to noise. Adequate rest periods are stressed as being important, and suitable rest facilities are required. In the past, the failure of employers to provide quiet rest areas in noisy workplaces, to give employees a break from constant noise during the working day, has been cited in claims for compensation through the Courts.

Regulation 6(4) is particularly significant. It says that the employer shall

(a) Ensure that employees are not exposed to noise above an exposure limit value, or

(b) If an exposure limit value is exceeded forthwith:

(i) Reduce exposure to noise to below the exposure limit value;

(ii) Identify the reason for that exposure limit value being exceeded; and

(iii) Modify the organisational and technical measures taken in accordance with paragraphs (1) and (2) and Regulation 7 and 8(1) to prevent it being exceeded again.

This may with the passage of time prove to be one of the changes in the Regulations which will be most subject to litigation. By virtue of the word 'shall' the provisions set out in Regulation 6(4)(a) appear to impose a strict liability upon any employer who exposes his employee to any noise above the exposure limit value of 87dB.

Moreover, where that limit is exceeded the Regulations seem to provide for immediate action to be taken by the employer to ensure that such exposure does not occur again. It appears, therefore, that employers have no excuse for exceeding the noise exposure levels referred to. It could be seen as a realisation that the problem of excessive noise has, finally, been addressed by legislation at Regulation 6(5) of the 2005 Regulations, which obliges employers to ensure that exposure to noise in such facilities is reduced to a suitable level.

Regulation 7:
Hearing Protection

The provision of hearing protection was originally dealt with in the 1989 Regulations at Regulation 8, where provision was made for employers to provide, at an employee's request, personal hearing protectors when noise was likely to exceed the first action level of 85dB. This requirement now applies to circumstances where noise exposure may exceed 80dB. Moreover, if an employer is unable by any other means to reduce the likely level of employee noise exposure to below 85dB (as opposed to 90dB previously), he is obliged to provide hearing protection even if it is not requested by a specific employee.

Turning to the designation of hearing protection zones, the wording is slightly altered from the previous Regulations. Originally, employers were only required 'so far as reasonably practicable' to demarcate and identify ear protection zones. Under the new Regulations, employers are absolutely obliged to ensure that in areas where an employee is likely to be exposed to noise at or above an Upper Exposure Action Value, the areas are designated 'hearing protection zones' and are demarcated and identified by means of a sign. It is also a requirement that access to those areas is restricted where practicable.

As regards the hearing protection itself, the reference in the 1989 Regulations to personal hearing protectors being 'suitable' no longer exists. The reasonable expectation that 'when properly worn' the protection will reduce the risk of damage to below the Second (or Peak) Action Level has also been omitted. It is merely stated in the new Regulations that any personal hearing protectors made available shall be selected by the employer to eliminate risk to hearing, or reduce the risk to the lowest level reasonably practicable.

It would therefore seem that no argument could now be brought by any Defendant in a deafness case to say that employees were not wearing hearing protection properly.

Regulation 8:
Maintenance and Use of Equipment

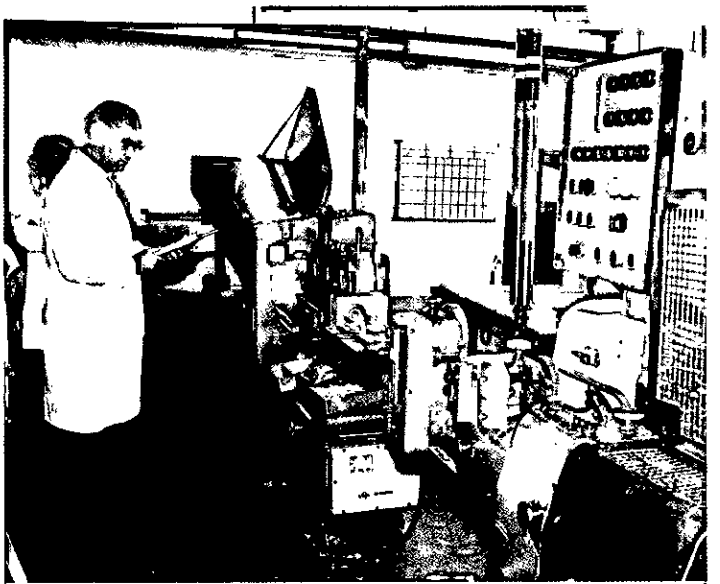
Under the old Regulations employers were only obliged 'as far as practicable' to ensure that any equipment they provided was maintained in a sufficient state, in sufficient working order and in good repair. This is no longer the case. The reference to practicability has been removed. There is now an absolute duty upon employers (in accordance with the Provision and Use of Work Equipment Regulations) to ensure that work equipment provided is maintained and is not defective. However, the new Regulations introduce provision for employees to make full and proper use of personal hearing protectors provided to them by employers, and to report any defects with their hearing protection as soon as is practicable.

This has relevance to some previous legal arguments put forward by Defendants in litigation that if hearing protection had been provided, employees would not have worn it, or alternatively, when hearing protection was indeed provided, that employees did not in fact make full use of it. A duty is thus placed on an employee to take some steps to help reduce his exposure to noise, with help of equipment provided to him by his employers.

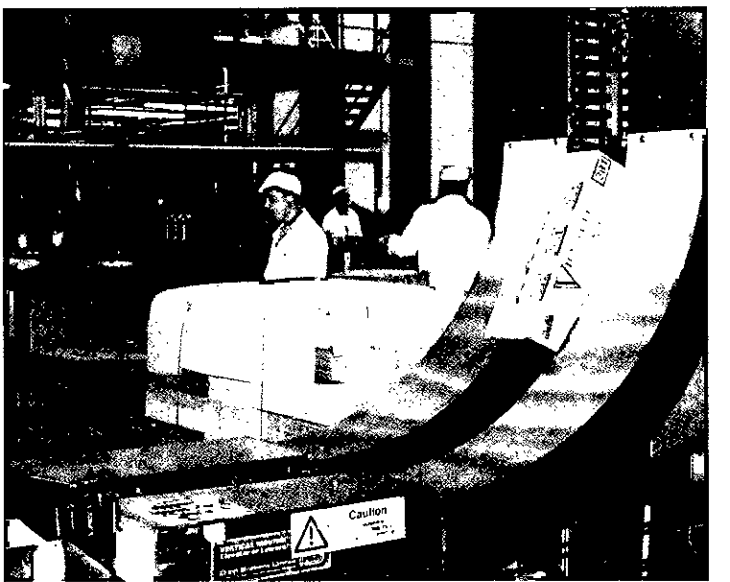
Regulation 9:
Health Surveillance

Specific provision is made within the Control of Noise at Work Regulations for employers to provide to employees with copies of risk assessments where a risk to an employee's health is identified in that risk assessment, and to keep up regular health surveillance on employees who continue to be exposed to noise. This specifically includes the testing of hearing. Such health surveillance records must be kept by the employer and provided to the employee if reasonable notice is given.

Moreover, if an employee is found to have identifiable hearing damage



It necessary, measure the level of noise to which employees are exposed



Many industries not previously regarded as particularly noisy will be affected

following such health surveillance, employers now have a duty to ensure that the employee is examined by a doctor, or relevant specialist, and that the employee is informed of the damage done. In the past, even when health surveillance had been performed it was often the case that employees were given no information on the results of such routine hearing tests until many years later. From the legal viewpoint, this could give rise to arguments on the part of Defendants (employers) in the event of litigation that claims for deafness are statute barred, when clearly there was no indication that an individual employee should have known that he was becoming deafened by noise: he was not told so by his employers. These new provisions should go some way to deal with this problem, and could be seen to serve the interests of good justice.

Under the Control of Noise at Work Regulations 2005 it is not sufficient for employers merely to monitor the health of their employees but do nothing further. They must be more proactive than was previously expected. If they identify a risk of damage to hearing following noise exposure, then at that time they must review risk assessments and the measures taken to eliminate or reduce noise. Employers should also consider assigning the affected employee to alternative work to remove him from further exposure to noise.

Regulation 10:
Information, Instruction and Training

Whilst Regulation 11 of the 1989 Regulations provided for employers to inform employees of the risk of damage to their hearing from noise exposure, there is now a wider duty on employers to provide information on the nature of all risks from exposure to noise to employees, not just that of damage to hearing. Also, whilst the original Regulation requiring the provision of information to employees provided for employers to give the employee information on what steps he could take to minimise that risk, the onus has now been shifted to employers to advise the employee on the organisational and technical measures which are being taken to reduce noise exposure, and to provide specific information on why, and how, to detect and report the signs of hearing damage.

The requirement of employers to provide suitable information, instruction and training on the risks of exposure to noise also extends under the new Regulations to any persons - whether employees are not - who are carrying out work on the employer's premises.

Regulation 11:
Exemption Certificates for Hearing Protection

There are still certain circumstances in which employers can obtain exemptions from providing hearing protection. However, these circumstances are exceptional and the new Regulations provide that such exemption certificates will only be granted after there has been full consultation with employers, employees and representatives. This extends the powers of employees and their representatives in the workplace when dealing with issues of noise exposure. Exemption certificates will even then only be granted if (1) the employer has taken steps to reduce risks to the lowest level reasonably practicable in respect of those risks associated with noise exposure, and (2) the employers will subject their employees to increased health surveillance in light of any such exemption.

Conclusion

Briefly, the Control of Noise at Work Regulations 2005 impose higher burdens upon employers to ensure that their employees are safe in the workplace from the risks associated with working in a noisy environment.

The Regulations probably improve the bargaining power of employees and their representatives in respect of steps to be taken in the workplace to reduce levels of noise. Employers are required to consult with them on health surveillance and noise assessment issues, as well as the steps to be taken to improve equipment.

The Regulations have been brought into line with the Provision and Use of Work Equipment Regulations to ensure that strict liability applies where excessive noise occurs due to faulty equipment in the workplace.

The lower and upper exposure limits can only be beneficial to employees in the workplace (and to potential Claimants in litigation). At the very least, the vague guidance given in the 1989 Regulations in respect of the preparation of noise assessments and risk assessments will no longer provide an escape mechanism in respect of liability for claims for personal injury arising from noise induced hearing loss and tinnitus.

In conclusion, the Control of Noise at Work Regulations 2005 go significantly further than their predecessors to afford much better protection in the future to workers from the risks associated with working in a noisy environment, especially future damage to hearing and the development of tinnitus. Finally, it seems that legislation is beginning to provide the protection long awaited by employees.

Sound Insulation of a Church Conversion

Joanne Miller. Miller Goodall Environmental Services Ltd

The revisions to Part E of the Building Regulations 2000 has placed a requirement on developers of properties converted into residential dwellings to undertake sound insulation testing to ensure sound insulation targets are achieved.

St Anne's Church was being converted from a conventional church building into ten individual properties. All the features of the church were being retained including the existing windows and stone arch structures, resulting in extremely distinctive properties. Ensuring that the sound insulation standards were achieved was a complex process.

The building was constructed in 1901. It required major refurbishment, whilst maintaining the existing façades and many existing features. A new floor was constructed to allow residential accommodation at ground and first floor levels. The floor construction was to be a 50mm Multideck with 110mm screed over the 254mm universal beams. The beams were underdrawn with two layers of 9mm plasterboard with staggered joints and given a plaster skim finish. The Multideck was supported by steel columns.

The most problematic issues of the conversion were the existing mullion windows, into which new party walls and party floors intruded. The partition walls between all residential units were of 230mm concrete block (1990kg/m^3) laid flat, with 18mm wet plaster finish. However, where these party walls met the existing mullions the thickness of the wall was reduced to approximately 100mm as shown in Figure 2. Where the floor between the ground and first floor met the large mullioned windows there was considerable concern about the sound insulation properties of the junction, as illustrated in Figure 3.

Visits were made to the site during the construction phase and advice was given to the developer on methods of improving sound insulation. One important point was a recommendation to seal all the holes into and out of the service duct to Apartments 1 and 4, ensuring that there were no gaps, particularly around the ventilation unit. This was best undertaken with a dense material such as brick/block and concrete rather than lighter-weight materials. The service ducts between the apartments also needed attention to ensure that any gaps were well sealed. It was also recommended that the voids beneath the window boards were filled before the installation of the window boarding.

Example results for an airborne sound insulation test and an impact sound transmission test for the timber and steel floor constructions, obtained during pre-completion testing, are shown in Figures 4 to 7.

The results are well within the requirements of the Building Regulations (D_{nTw} a least 43dB, and L_{nTw} no greater than 62dB) for both tests on the timber floor and for the airborne test on the steel frame floor. However the result for the impact test on the steel frame floor was only just within the standard, with an L_{nTw} of 60dB. The results show that the higher frequencies were not well attenuated by the steel framed floor construction, as shown in the area of the circle on Figure 7. This was also the subjective impression gained while carrying out the test: a high pitched metallic noise was evident during the tests. A pre-test before full completion of the project identified that there was a certain amount of noise resonating down the steel columns, and these were subsequently boxed in and insulated (as shown in Figure 3). This provided an improvement of 1dB.

The results demonstrate that even though the site was far from ideal in terms of its appropriateness for textbook sound insulation methods, it was possible through good and detailed workmanship to provide a property which achieved the sound insulation standards of the Building Regulations.

The assistance of the ANC in sourcing and compiling this article is gratefully acknowledged.

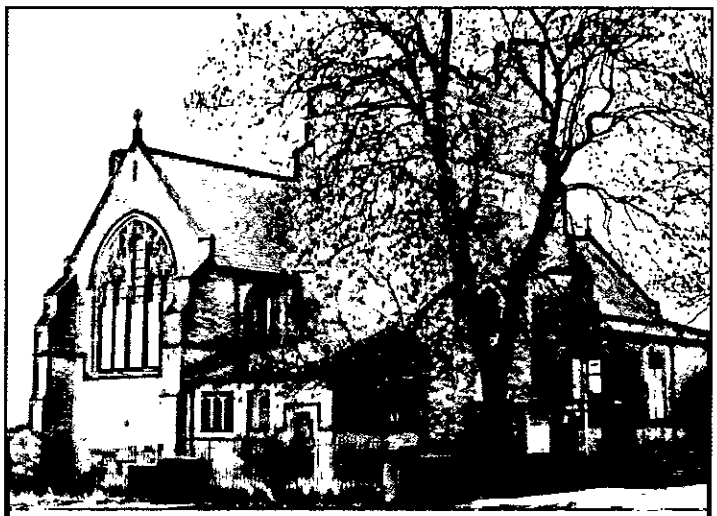


Figure 1: An exterior view of the building

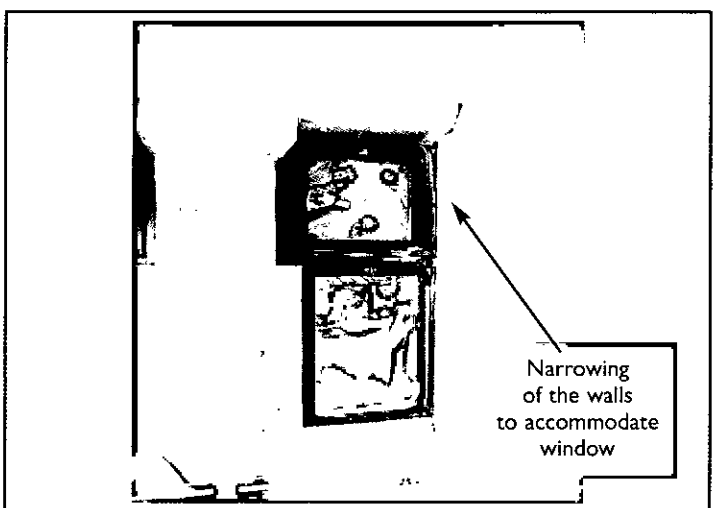


Figure 2: Party wall construction meeting the mullion windows

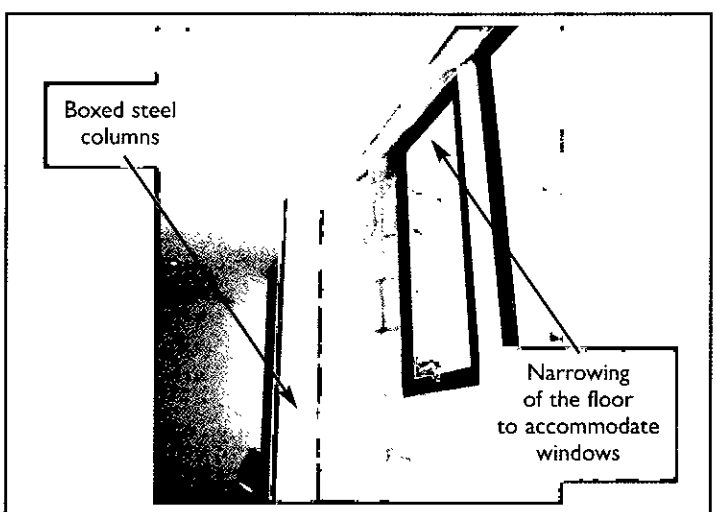


Figure 3: Ceiling joint with mullion window and boxed-in supporting column

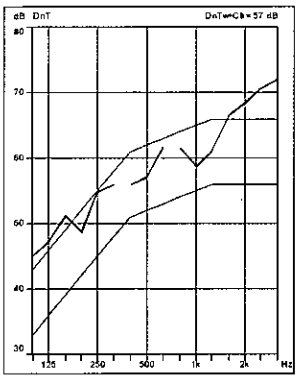


Figure 4: Example airborne sound insulation test of a timber floor.

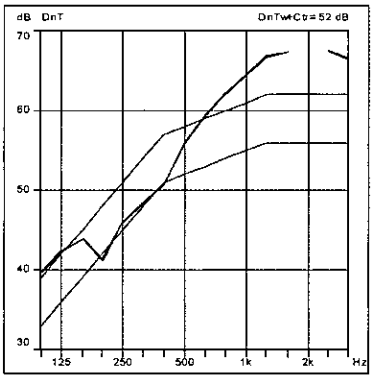


Figure 6: Example airborne sound insulation test of a steel floor construction.

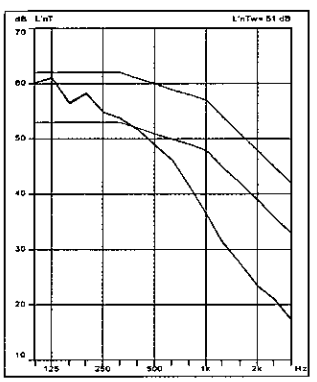


Figure 5: Example impact sound transmission test of a timber floor.

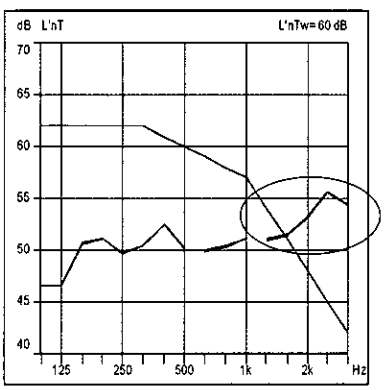


Figure 7: Example impact sound transmission test of a steel floor construction.

Parliamentary Reports

From Hansard

Commons Written Answers

27 February 2006: Aircraft noise

Justine Greening: To ask the Secretary of State for Transport how many people are exposed daily between 0500 hours and 0700 hours to levels of noise from air traffic at Heathrow exceeding World Health Organisation guidelines 'Guidelines for Community Noise' and if he will make a statement.

Ms Buck: We do not monitor noise exposure around Heathrow airport in this format. Contour maps for night time noise exposure between for the night (2300-0700) and night quota period (2330-0600) were published in July 2004 as part of stage one of our consultation on night flying restrictions at Heathrow, Gatwick and Stansted Airports. The area of contour and population within the contour were also shown.

Justine Greening: To ask the Secretary of State for Transport how many aircraft movements have taken place at Heathrow between (a) 2330 hours and 0600 hours and (b) 0600 hours and 0700 hours in each year since 1993; and if he will make a statement.

Ms Buck: The following table shows the number of aircraft 'movements at Heathrow Airport during the night quota period (2330-0600) between 1993 and 2005.

Certain types of aircraft are exempt from movement limits if their noise certification data are below a certain level. Jet aircraft with a maximum certificated weight not exceeding 11,600kg and propeller aircraft are exempt from the movements limits and noise quotas if their noise certification data are less than 87 Effective Perceived Noise Decibels - the measurement unit for formal certification of aircraft noise. These are recorded as exempt types. In addition, movements may be granted dispensations in certain cases, and disregarded from the night restrictions. The night restrictions regime is set on a seasonal basis (the seasons change with the clocks) rather than by calendar year.

We have not stored comprehensive historic data about movements between 0600 and 0700 hours at Heathrow Airport.

3 March 2006: Hillingdon Education Authority

John McDonnell: To ask the Secretary of State for Education and Skills what assessment she has made of the additional costs falling upon Hillingdon Education Authority from Heathrow airport.

Jacqui Smith: Hillingdon does not receive additional funding specifically because Heathrow airport is in its local education authority area. Nevertheless, the current revenue funding formula recognises that Hillingdon has well above the average numbers of children from ethnic minority families and has well above the average costs of recruiting and retaining staff. In 2005-06 its SFSS allocation was £3,679 per pupil: the 28th highest allocation in the country. In addition, it was allocated £1,081,611 of Ethnic Minority Achievement Grant.

On capital, we are aware of the problems of aircraft noise in schools near the airport. The Department provides significant capital resources which can be used for noise reduction, where that is a local priority. Hillingdon and its schools are receiving over £50 million across the three years 2005-06 to 2007-08. I also understand that BAA recently set up a voluntary compensation scheme which covers schools affected by airport developments in circumstances where the noise levels are over 63 dB(A) (16 hours time-averaged level). The total fund made available by BAA amounts to £5 Heathrow Airport

6 March 2006: Hearing loss claims

John Mann: To ask the Secretary of State for Trade and Industry how many individual claimants have been informed by his Department that their case is being delayed due to negotiations over costs payments for noise-induced hearing loss claims to his Department due to breach of section 4 (2)c of the Conditional Fee Agreement Regulations 2000.

Malcolm Wicks: Payment of compensation by the Department's claims handlers would not be delayed by negotiations over solicitors' costs.

John Mann: To ask the Secretary of State for Trade and Industry whether references have been made to the Serious Fraud Office concerning breaches of rule 4(2)c of the Conditional Fee Agreement Regulations 2000.

Malcolm Wicks: No such reference has been made to the Serious Fraud Office. It is not a matter for them but one for the courts to resolve.

7 March 2006: A47 (Peterborough)

Mr Stewart Jackson: To ask the Secretary of State for Transport what estimate he has made of the number of households in the Peterborough constituency adjacent to the A47 which are adversely affected by noise; what estimate he has made of the decibel levels concerned; and if he will make a statement on the acoustic screening on that stretch of trunk road.

Dr Ladyman: Noise calculations were undertaken for two locations on the A47 in the vicinity of Peterborough based on noise surveys carried out in October/November 2005. The calculated roadside noise levels, obtained as part of that site assessment, are 79dB(A) and 78dB(A) for Eye bypass and Castor bypass respectively.

No locations alongside the A47 were identified as sites at which known noise problems existed and thus have not been included on the list of locations meeting sift criteria announced on 22 March 1999, for which noise problems are being mitigated in conjunction with a £5 million ring-fenced budget.

Peterborough City Council assisted with a study of the noise impact on residential properties at Aspley Way, Longthorpe but this has not resulted in a proposal to increase the provision of acoustic screening along this section of the A47.

8 March 2006: M20

Hugh Robertson: To ask the Secretary of State for Transport when the Government plans to resurface the M20 between junctions 8 and 9 with a noise reducing surface; and why plans for the resurfacing have been delayed.

Dr Ladyman [holding answer 6 March 2006]: As the surface of the M20 between junctions and 8 and 9 is currently in a satisfactory condition, resurfacing will not be required for at least the next five years. When resurfacing is carried out, a lower noise surface will be used.

8 March 2006: Night noise levels

Mr Spellar: To ask the Secretary of State for Environment, Food and Rural Affairs what action her Department is taking to reduce noise levels at night.

Mr Bradshaw: The Clean Neighbourhoods and Environment Act 2005 extends the night noise provisions in the Noise Act 1996 to licensed premises. Local authorities will be able to fine those responsible for excess noise from licensed premises between 11 pm and 7 am. Those found responsible for exceeding the permitted level of noise will be liable to a fine of up to £5,000 upon summary conviction. A local authority will be able to offer the responsible person the option to discharge liability to conviction with the payment of a fixed penalty notice of £500 within 14 days. It is planned to bring these provisions into force in the autumn. They will complement the power to close licensed premises on noise grounds introduced by the Anti-social Behaviour Act 2003.

The Clean Neighbourhoods and Environment Act 2005 also gives local authorities new powers to designate alarm notification areas in which it will be a requirement for those with intruder alarms to register key-holder details with the local authority. Local authorities will be able to contact key-holders in the event that an alarm sounding for 20 minutes continuously or one hour intermittently causes annoyance to those in the vicinity. Local authorities will also be able to enter premises without force, where possible, to deactivate an

alarm, and to obtain a warrant to force entry where this is not possible. Silencing misfiring intruder alarms as quickly as possible is particularly important at night. These new powers, which will be commenced in April, are additional to the existing statutory nuisance powers under Part III of the Environmental Protection Act 1990.

The Government is also taking steps to reduce environmental noise at night. The Department for Transport has responsibility for controlling aircraft noise at night at Heathrow, Gatwick and Stansted Airports. Restrictions, comprising a movements limit and supplementary noise controls, are set on a seasonal basis for a 5-6 year period. The Department has recently consulted on a night restrictions regime to apply from October 2006 at Heathrow, Gatwick and Stansted.

At regional airports noise restrictions are set by the Airport Operator, in accordance with any planning conditions which may apply.

9 March 2006: Hearing loss claims

John Mann: To ask the Secretary of State for Trade and Industry how many costs payments have been refused for cases by (a) Berefords solicitors, (b) Bakewell solicitors, (c) Heptonstall solicitors, (d) Brown and Co. solicitors, (e) Ollerenshaw solicitors and (f) UDM/Vendside for noise-induced hearing loss claims to his Department due to a breach of section 4 (2)c of the Conditional Fee Agreement Regulations 2000.

Malcolm Wicks: In the case of the UDM/Vendside, there is no conditional fee agreement and no dispute over costs. For the other named solicitors, this information is not readily available. Miners' hearing loss claims are not schemed so solicitors' costs for each claim are dealt with on their own merits. Concerns relating to a breach of regulation 4 of the conditional fee regulations would be raised as part of the negotiations on the appropriate level of costs for any given claim.

20 March 2006: Anti-social Behaviour Act

Dr. Kumar: To ask the Secretary of State for Environment, Food and Rural Affairs on how many occasions powers introduced in the Anti-Social Behaviour Act 2003 have been used to deal with environmental crime.

Mr. Bradshaw: The following figures are available on the use of new powers introduced under the Anti-social Behaviour Act 2003 for tackling enviro-crime:

Sections 40-41 introduced the power for local authorities to shut noisy premises for up to 24 hours in order to address or prevent a public nuisance. We do not have information on how many times this power has been used.

Section 42 removed the requirement for local authorities to adopt the Noise Act 1996 and provide a specific level of noise service before the Noise Act 1996 could be used. In 2004-05, one fixed penalty notice was issued by local authorities in England for night noise offences.

Sections 43-47 introduced new fixed penalty notices for graffiti and flyposting. In 2004-05, 19 fixed penalties were issued by local authorities in England for graffiti offences and 57 for fly-posting.

Sections 48-52 introduced a power for local authorities to issue Graffiti Removal Notices requiring the clean-up of property defaced by graffiti; however, these powers have so far been available only in 12 pilot areas and the Government are not aware of any notices having been issued. This is largely due to the establishment of partnership arrangements in these areas for dealing with graffiti defacement.

Section 54 made it an offence to sell aerosol paints to under 16-year-olds. No records of prosecutions under s.54 of the Act were notified for 2003 and 2004. Statistics for 2005 will be published in the autumn.

Section 55 extended certain enforcement powers to local authorities for use when investigating fly-tipping offences. No national data are collected on how frequently these powers are used as this is a matter for local authorities based on local enforcement policies. There is anecdotal evidence, however, that local authorities have been using these powers, particularly the stop and search powers, and that they have been extremely helpful to them when dealing with fly-tipping offences.

20 March 2006: Noise Act

Shona McIsaac: To ask the Secretary of State for Environment, Food and Rural Affairs which local authorities have not adopted the terms of the Noise Act 1996 in relation to night-time noise.

Mr. Bradshaw: The Noise Act 1996 was amended by the Anti-social Behaviour Act 2003 to remove the requirement of adoption. All local authorities can use the powers in the Noise Act 1996 to deal with night-time noise.

21 March 2006: Noise Pollution

16. Michael Gove: To ask the Secretary of State for Transport if he will make a statement on Government policy on noise pollution from airports in the South East.

Derek Twigg: Our basic aim is to limit and, where possible, reduce the number of people in the UK significantly affected by aircraft noise. This aim applies to the South East as it does to the rest of the UK.

The Government set noise-related operating restrictions at Heathrow, Gatwick and Stansted airports, which include departure noise limits and night flying restrictions. At other airports, a range of similar measures are implemented by the airports themselves, responding to local circumstances.

In 'The Future of Air Transport' white paper we set out the measures we wish to see larger UK airports (with over 50,000 movements a year, by jet aircraft over 34,000 kg) apply as a benchmark for mitigating aircraft noise.

22 March 2006: Noise limits

Mr. Hayes: To ask the Secretary of State for Transport what assessment he has made of the likely impact of Commission Decision 2006/66/EC,, OJ L37 of 8 February 2006, on (a) UK noise limits for (i) pass-by freight, (ii) stationary freight, (iii) locomotives, (iv) multiple units, (v) trailers, (vi) other stock, (vii) driver's cab limits and (b) existing and planned (A) track and (B) rolling stock; what UK derogations and exceptions apply; what the estimated total cost is of required adaption; what time period is permitted; and if he will make a statement.

Derek Twigg: This decision brings in limits for externally emitted noise from trains. These have no equivalent in existing UK legislation. It also brings in short time limits for loud noise in the driver's cab which will apply as well as the longer term exposure limits set in the Control of Noise at Work Regulations 2005.

New rolling stock has to comply after a transitional period of two years. The design of new UK freight rolling stock is such that it is already likely to be compliant. The UK has negotiated permanent specific cases for locomotives and diesel multiple units to allow for the constraints that the limited UK loading gauge presents to fitting onboard noise shields, but there may be a small increase for cab soundproofing in the cost of new locomotives. For refurbished rolling stock it is only necessary to demonstrate that noise has not been increased. There is no impact on track.

Lords Written Answers

29 March 2006: Royal Navy Sonar

Baroness Miller of Chilthorne Domer asked Her Majesty's Government whether they have made an assessment of the threat to wildlife posed by man-made ocean noise.

The Parliamentary Under-Secretary of State, Department for Environment, Food and Rural Affairs (Lord Bach): This Government is taking action to explore the potential impact of undersea noise on the marine environment, particularly marine mammals. For example, Defra commissioned research from the Zoological Society of London in 2004 to look at the feasibility of examining the ears of stranded dead cetaceans to see if they show any signs of damage from marine noise. The results of this research are due to be reported to my department in May 2006.

The results from this project will advance the objectives of ASCOBANS (Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas). It will also make a valuable contribution towards the UK's cetacean biodiversity action plans, which call for studies into the effects of underwater sounds on cetacean species.

In addition, the Department for Trade and Industry is currently funding two projects, which are being carried out by Subacoustech Ltd. The first of these is estimating, measuring and controlling the environmental effects of man-made noise on the marine environment. The second project is a feasibility and demonstration study based on active and passive detection of marine mammals.

Oxford Hospital Trust Makes a Sound Investment

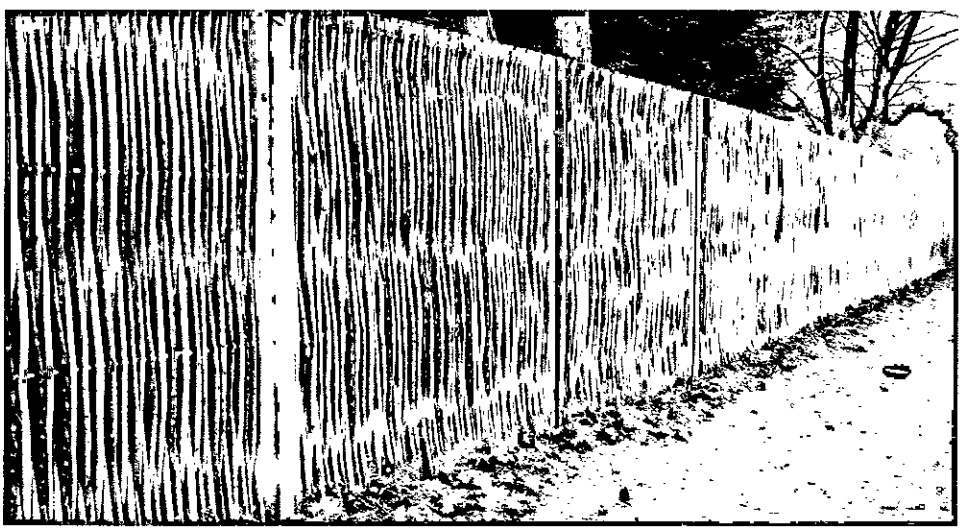
Traffic and construction noise on neighbouring homes

John Radcliffe Hospital Trust has commissioned the installation of a 230 metre acoustic Green Barrier™ to reduce the effect of traffic and construction noise on neighbouring homes. The Green Barrier by ETS Ltd was chosen after a consultation exercise organised by the hospital and their architects Gray, Baynes and Shew.

This method of noise control provides an aesthetically pleasing barrier in an environmentally sensitive way. Manufactured from sustainable materials, the Green Barrier™ used at JRH is formed by sandwiching a high performance acoustic core between two woven willow panels. The net effect of the will be a marked reduction in noise which cannot be provided by normal concrete or timber noise barriers.

The architect David Welbourne of Gray Baynes & Shew of Oxford made the comment that the prominent position and the physical size of the screen (approximately 200m long and on average 2.5m high) proved quite a challenging problem the designers to resolve. They needed to find a solution that not only had to be aesthetically pleasing (on both sides) and flexible enough to cope with the changing topography of our site, but also had to satisfy the specific acoustic performance requirements established by the project acoustician. After extensive research in the market place it was found that only the Green Barrier could satisfy all the design criteria. Although only just completed the screen has more than lived up to expectations and there was already some very positive feedback from the client and the local residents.

The Green Barrier is manufactured and installed by ETS Ltd, who can be contacted at **sales@etsluk.com** or via their website **www.etsluk.com**



BSI eShop Announced

Enabling customers to purchase and download standards and books directly to their desktops

BSI Business Information has announced the launch of the BSI eShop, following a period of development, which enables customers to purchase and download standards and books directly to their desktops as a PDF file via a secure credit card facility. BSI Business Information is a leading provider in best practice solutions through the development and publication of standards and business-related books. The portfolio of publications is about improving systems, applications and processes in business, trade and industry, public and private sector. The emphasis is firmly on the application of best practice in all sectors of the working environment.

Offering a selection of popular standards and books in key business disciplines, the eShop makes it even easier for customers to obtain the information they need to implement industry best practice, ensure compliance and achieve business excellence as and when they want it.

In what is an exciting development not only for BSI but for its customers too, BSI's Publishing Manager Simone Levy said that the new eShop was a huge step forward in providing customers with information they want at the click of a button. Customers now had immediate access to around 70 publications.

Both user-friendly and straightforward, the eShop makes buying standards and books even easier. It is clearly set-out and divided according to industry sector, and all relevant publications are listed with a summary and contents following a brief introductory paragraph highlighting the main issues within the industry.

The following categories are covered:

- Risk management
- Information and technology
- Construction and fire safety
- Environmental management
- Health and safety management
- Quality management.

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Noise Regulations Come Into Force

HSE - Control of Noise at Work Regulations 2005

The Health and Safety Executive (HSE) is reminding employers that the Control of Noise at Work Regulations 2005 came into force on 6 April 2006. The regulations replace the existing Noise at Work Regulations 1989 for all industries in Great Britain except music and entertainment, which have until April 2008 to comply.

Welcoming the new Regulations Health and Safety Minister Lord Hunt of Kings Heath said that with over one million employees in Great Britain exposed to levels of noise at work which could damage hearing, the new Regulations would reduce exposure without placing unnecessary burdens on employers. It was hoped that full compliance with the regulations would eliminate all new cases of hearing damage caused at work by 2030. The Regulations put the emphasis on identifying measures to eliminate or reduce risks from exposure to noise at work rather than simply relying on hearing protection, although this may also be needed in the short term.

Workplaces which fell within the scope of the 1989 Regulations should already have measures in place and the main effect is likely to be a need to review their risk assessments and prioritise their noise-control measures. Employees whose use of hearing protection under the 1989 Regulations was advisory will now have to wear the protection supplied. Brian Lamb, Director of Communications at RNID, says that his organisation welcomes the new Control of Noise at Work Regulations. Prolonged exposure to loud noise could cause permanent hearing loss and employers had a legal duty to cut down noise and protect their employees from the harmful effects of noise at work. However, employees also had to play their part and use the hearing protection available to them. Because noise-induced hearing loss was often cumulative and not immediately obvious, so its threat was seldom recognised or taken seriously. Whilst the effects of noise are irreversible, noise induced hearing loss was totally preventable.

Employees newly covered by the Regulations are at relatively lower risk, and the employer will need to put in place proportionate noise reduction measures and provide hearing protection on request.

The simple rules of thumb that may indicate a noise problem are:

- Employees are surrounded by intrusive noise for most of the working day;
- They have to raise their voices to be heard by someone just 2 metres away, for at least part of the day;
- They use noisy powered tools or machinery for more than 30 minutes a day;
- To review experience from the use of tarThey work in a noisy industry such as construction, road repair, engineering or manufacturing;
- Their work causes impacts such as hammering, drop forging, pneumatic impact tools etc;
- They work with explosive sources such as cartridge-operated tools, detonators, or guns.

The Control of Noise at Work Regulations 2005 require employers to:

- Assess the risks to their employees from noise at work;
- Take action to reduce the noise exposure that produces those risks;
- Provide their employees with hearing protection if they cannot reduce the noise exposure enough through other methods (making hearing protection available on request at 80 dB and ensuring it is worn at 85dB);
- Make sure the legal limits on noise exposure (87dB daily or weekly exposure or peak sound pressure of 140dB taking account of hearing protection) are not exceeded;
- Provide employees with information, instruction and training;
- Carry out health surveillance where there is a risk to health.

The main changes in the Regulations are to lower exposure action levels. As of 6 April these have been lowered by 5dB in comparison with the 1989 Regulations, to 80dB for the lower exposure action value and to 85dB for the upper exposure action value.

Employers should always be looking to eliminate or reduce risks from noise, and the exposure action values are points at which the employers must take specific action. At the lower exposure action value a risk assessment is needed, employees told about the risks and hearing protection must be made available on request; and at the upper exposure action value noise control should be part of a planned programme, hearing checks are needed and hearing protection must be used.

Exposure is assessed over a working day, or a working week if exposure varies markedly from day to day. Exposure to members of the public from their non-work activities is not covered by the Regulations. Low-level noise, whilst it may be a nuisance, presents no risk to hearing damage and is not covered by the Regulations.

Employers in the music and entertainment sectors have a further two years' transitional period, as the new Regulations do not come in to force in these sectors until 6 April 2008. Meanwhile they must continue to comply with the Noise at Work Regulations 1989 by ensuring they minimise the risk of hearing damage to their employees.

The HSE has produced a simple guide to the Regulations and advice for employers to reduce exposure. This can be downloaded from **www.hse.gov.uk/pubns/indg362.pdf**

For more information about the Regulations and simple steps that can be taken to reduce employee noise exposure visit: **www.hse.gov.uk/noise**

Copies of Controlling noise at work L108, ISBN 0 7176 6164 4, price £13.95, are available from HSE Books, PO Box 1999, Sudbury, Suffolk CO10 2WA, tel: **01787-881165** or fax: **01787-313995**
Priced publications are also available from good booksellers.

Public enquiries can be made to the HSE's InfoLine, **0845 3450055**, at Caerphilly Business Park, Caerphilly CF83 3GG.

Noise from Pubs and Clubs: Research Project

To establish a methodology and criteria for the assessment of music noise

Jim Griffiths, the Acoustic Director of Capita Symonds, is pleased to announce that the company has partnered with the Building Research Establishment (BRE) to win a high profile research project to establish a methodology and criteria for the assessment of music noise from pubs and clubs.

Conflicting views on acceptable noise limits from music emanating from licensed pubs and clubs has been the subject of much debate for many years.

The primary focus of the research will be providing noise guidance for the proposed extension of the Noise Act to cover licensed premises. The work will include detailed laboratory tests followed by field trials in selected pubs and clubs throughout England and Wales.

Capita Symonds, a division of the Capita Group plc, provides a broad range of professional services covering the design, engineering, construction, infrastructure and property markets. With 3,100 staff in 45 UK offices and a projected turnover of £160m Capita Symonds is one of the UK's newest multidisciplinary consultancies with a comprehensive and diverse project portfolio. The division is the result of the merger between Capita Property Consultancy and Symonds Group and was officially launched on 1 June 2004.

Further information can be found at: **www.capitasymonds.co.uk**

"Mosquito"

The Sonic Teenager Deterrent

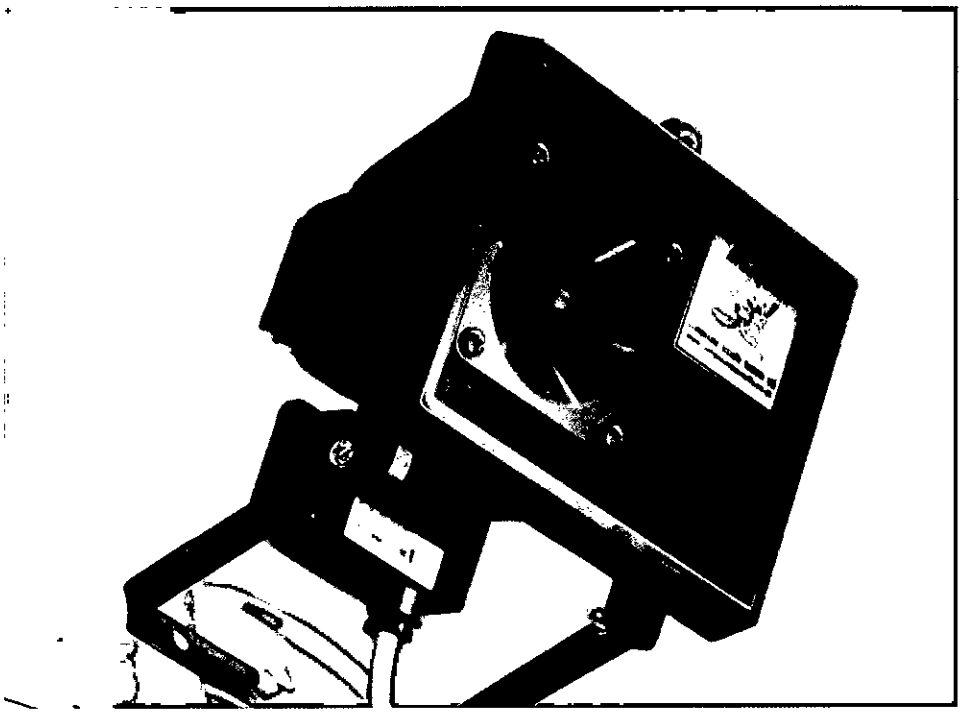
As a form of revenge against disruptive youth, this seems almost too sweet - a device that annoys teenagers so intensely they have to disperse and loiter somewhere else.

Several police forces have given their backing to a device that sends out an ultra high-pitched noise that can be heard only by those under 20 years old, and is so distressing it forces them to clutch their ears in discomfort. Eventually they can stand it no longer and have to move on. Because the body's natural ability to detect some frequencies diminishes almost entirely after 20, adults are completely immune to the sounds.

The Sonic Teenager Deterrent, nicknamed the Mosquito because of its sound, has proved so successful in warding off gangs from trouble-spots that it has been endorsed by the police and local authorities. The black box, which can be attached to the outside wall of shops, offices and homes, sends out 80dB bursts of pulsing sounds at up to 16kHz. It sounds to youngsters like a demented insect or a very badly-played violin, but for adults it is hardly detectable. What is more, shop owners can control the strength of the signal as the problem of loitering youths ebbs and flows, and the sound does not penetrate indoors.

The system was the brainchild of Howard Stapleton, a businessman and former electronics apprentice at British Aerospace, who was sick of youths hanging around outside his local shop and intimidating customers. He remembered visiting a factory run by his father when he was 12 and finding the noise unbearable even though the adults with him were unmoved. He was told the high frequency was perceptible only to the ears of youngsters. Working in his bedroom in Merthyr Tydfil, and using his four children as guinea pigs, he came up with a prototype of his device and asked the local shop to test it. 'I got it so that only my kids hated it and my fianceé and I were completely unperturbed,' he said. 'We put up the prototype outside the store and almost immediately people stopped congregating. The beauty of it is that the noise does not have to be loud, just pitched at the right level which affects teenagers. We didn't have any complaints from the other customers and it causes no physical damage. The 20-year-old cut-off is not absolute but 90% of people under 20 can hear it and 90% of people over 30 cannot.'

Mr Stapleton, whose company manufactures 50 of the £622 devices a week, has been inundated with requests for supplies. A number of police forces and councils have endorsed the system and want to install them at trouble spots. He has even had an enquiry from a headmaster who wanted to connect them to smoke detectors in his school toilets to stop the pupils smoking.



Inspector Amanda Davies of Staffordshire Police, which has given the device to shopkeepers in the Moorlands area, said: 'It is controlled by the shopkeepers - if they can see through their window that there is a problem, they turn the device on for a few minutes until the group has dispersed. Shop owners have reported fabulous results.'

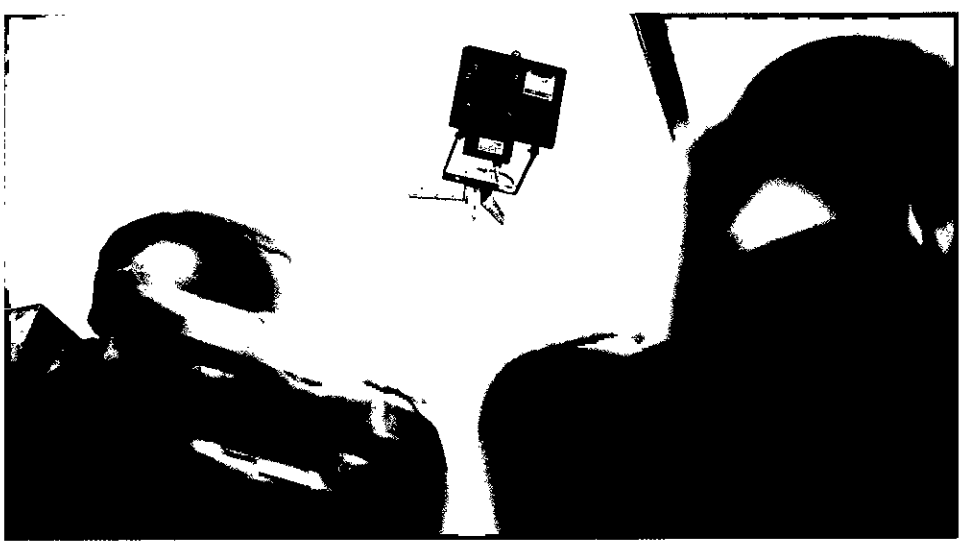
Rochdale council is one of the first local authorities to adopt the device. Lee Durrant, a council spokesman, said: 'If it proves a success, we would look to buy more units for shops, bus stations and anywhere we are experiencing problems.'

Clare Pritchard, the manager of a McDonald's restaurant on the outskirts of Manchester, bought the device to ward off teenagers using the car park to meet and illegally drink alcohol. 'It has definitely reduced the number of kids hanging around here,' she said. 'None of my customers has complained, although some of the staff have said it is driving them mad.'

During a test run a 14 year old volunteer from Biddulph, Cheshire, clasped his hands to his ears the minute he stepped outside. 'I can't stand it,' he shouted. 'It's a loud, piercing noise. It feels like my ears will pop.' His 13 year old friend from the same village, agreed: 'It's very annoying. I don't think I've ever heard anything like it before.'

Angela King, an audiology specialist at the Royal National Institute for Deaf People, said adults suffered progressive hearing loss from their twenties onwards and that the higher frequencies were the first to go. She said: 'The frequency at which it operates is at the very limits of our hearing and will be heard only by youngsters. It is like when people are young they can hear the noise of bats but not when they are older. Over the years cells in the inner ear die or are damaged and the ones that go first are the ones that hear higher frequencies.'

(report courtesy of Daily Telegraph)



Entec UK & Hepworth Acoustics Deliver First "Noise Mapping England" Maps

For The Defra Noise Mapping England Project

Environmental consultancy Entec UK and noise consultant Hepworth Acoustics have combined to deliver completed road noise maps to Defra under the Noise Mapping England project. Entec UK Ltd is a leading multi-disciplinary environmental and engineering consultancy with around 700 staff and associates working in 10 main offices across the UK. Approximately half of Entec's staff is engaged in environmental consultancy business. Hepworth Acoustics has carried out noise maps of all major types of noise source including roads, railways, industry, quarries and aircraft (and various combinations of the above). The company is virtually unique in the UK in having experience of all of the main noise mapping software that implement UK standards. The two new maps cover the Manchester and Merseyside conurbations, a total area of 2000kmÇ, as part of a series of 15 contracts commissioned by Defra to cover over 20 major towns, cities and regions in England.

The key aim of the Defra Noise Mapping England Project (**www.noisemapping.org**) is to gather information on the ambient noise climate in England. In simple terms, this means determining the number of people affected by different levels of ambient noise, the source of the noise (road, rail, air and industry) and the locations of the people affected. The project is calculating noise levels and producing noise maps across England to determine noise exposures, identify relatively quiet areas and noise 'hot spots' and provide information to assess the relationship between noise and other policy areas. This information will be used to gain knowledge on the location, acquisition and accuracy of input data, which will assist in the implementation of the Environmental Noise Directive.

Within the project, Entec and Hepworth Acoustics have undertaken a series of project tasks, including a detailed field survey of noise barriers across the two areas; GIS processing and analysis of detailed terrain, buildings and traffic survey data sets; and development of detailed resolution noise models. Owing to the large geographical area and detailed resolution required, the project team used specialist Lima noise mapping (produced by German firm Stapelfeldt) and ArcGIS software. In total, more than seven million calculation points were calculated at a horizontal grid resolution of 10m, resulting in highly detailed maps for the two contract areas. These outputs have recently been delivered to Defra together with technical reports describing the processing steps undertaken and modelling techniques adopted.

Contact Neil Thurston, Entec UK
Tel: **01743 342704**
E-mail: **thurn@entecuk.co.uk**

or Peter Hepworth, Hepworth Acoustics
Tel: **01925 579100**
E-mail: **peter.hepworth@hepworth-acoustics.co.uk**

How Good is Voice Recognition?

Can particular individuals always be recognised? Do they have to be speaking quite slowly and with normal intensity? How much background interference can be tolerated?

I often listen to music on the radio. I tune to generally acceptable stations, but sometimes they slip in completely unacceptable artists. I then have to rush to change to another station, risking injury as I leap across the room.

Sometimes the unpleasantness affects me because of the artist's musical characteristics; other times it is the loathsomeness of the artist as a human being. Think about Phil Collins. But it is certainly not always the composition itself: Celine Dion would be switched off, but Jennifer Rush would stay on.

Given a reasonable quality digital radio, how technically feasible would it be to use voice recognition software to change stations when unacceptable artists started their 'music'? Ideally, the artist would need to be recognised within a few seconds. One would presumably have to train the system to one's tastes as new unacceptable artists arrive on the scene - Dido, James Blunt (argh!). Could groups of artists and musical styles also be recognised - eg boy bands, rap, Lloyd Webber (so goodbye Puccini as well)?

Peter Brooker

[If voice recognition software could be used to change Renee Fleming into Cecilia Bartoli, I'd buy it! - Ed.]

Larson Davis

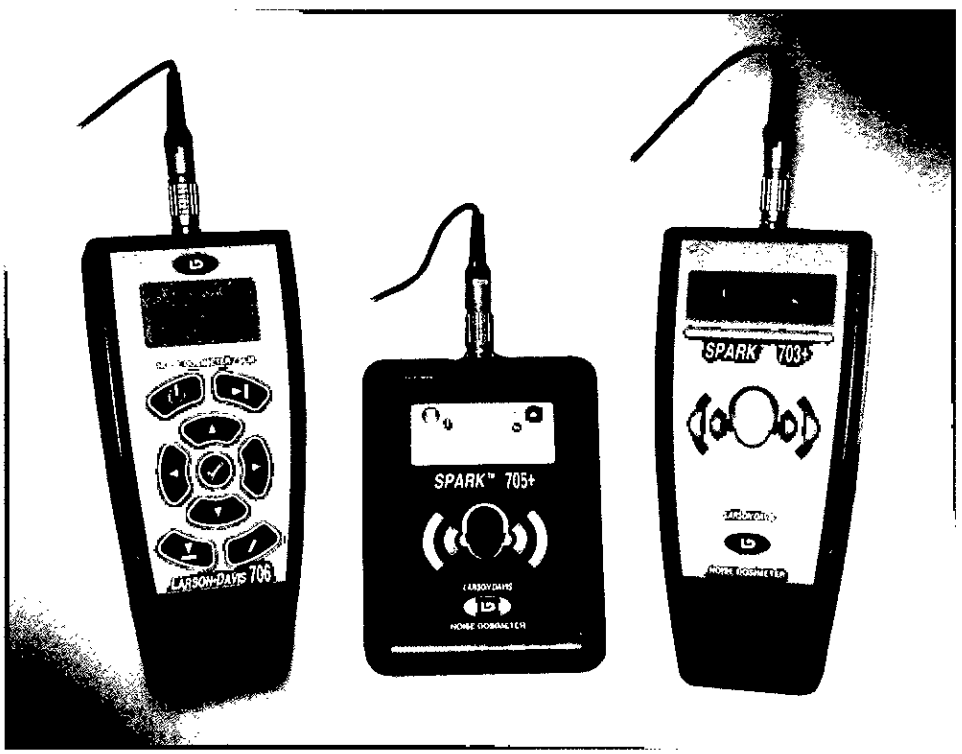
Receives European ATEX approvals for its Spark dosimeters

Larson Davis, a PCB Group Company, has announced that it has received European ATEX approvals (II 2 G, EEx ib IIB T4) for its Spark dosimeters. The approval extends to all dosimeters in the product family, and allows them to be used in hazardous surface locations for industrial hygiene and worker safety applications.

The dosimeters combine ease of use and strength in a miniature, lightweight package. The seven intrinsically safe models available provide days of operation on two AA batteries, and windscreens stay secured between calibrations. When used with Larson-Davis Blaze software for noise exposure analysis, personal noise dose data can be converted into concise reports and full-color graphics.

The company has also announced an enhancement of the Soundtrack LxT sound level meter to include a comprehensive time history data logging option. The meter offers an innovative approach to sound measurement for compliance and worker noise exposure monitoring. Available in Type 1 or Type 2 versions, it provides an easy way to manage route or task-based workplace noise surveys. With operator route prompts and digital voice annotation, surveys are done quickly and easily by operators at all skill levels, says the manufacturer. Optional integrated real-time octave and third-octave filters perform frequency band analysis instantly with no tedious 'step-through' required.

Finally, the Human Vibration Meter (HVM) utility software known as HVManager, for vibration exposure assessment and management, has been designed to provide instantaneous tool assessments to all new standards, including the HSE recommended points system; EU physical agents directive 2002/44/EC; ISO 5349; and ISO 2631. With an easy to use graphical user interface (GUI) and one click of a button, HVM100 data can be downloaded directly from the instrument and saved into a tool database. This permits users and manufacturers of vibrating equipment to create databases of measurements for hand-arm and whole-body vibration. Daily vibration exposure for a worker using multiple tools for varying activities can then be generated in a single report.



Each measurement can be included for each tool or ignored, by simply selecting appropriate files. The tool is given a rated level based on averaged results. After collation of a comprehensive tools database, the system can be used to provide each worker with a vibration risk management record. This tool helps employers ensure legal compliance of vibration equipment users, enable exposure analysis in different scenarios, and optimise work procedures. The utility software connects to the Model HVM100 Human Vibration Meter for the seamless importation of data.

Larson Davis provides a complete line of acoustic and vibration measurement systems, including dosimeters, sound level meters, preamplifiers, real-time analysers, digital sensing systems, human vibration meters, microphones and calibrators for audiometric calibration, building acoustics, environmental noise monitoring, sound intensity, sound power testing in test and measurement, automotive, industrial, aerospace, and industrial hygiene applications. All Larson Davis products are accompanied by full technical support, as well as a guarantee of total customer satisfaction.

For more information: contact Larson Davis at **www.LarsonDavis.com** or **+00(1) 716 926 8242**

PCB Piezotronics

Launches newly redesigned home page

PCB Piezotronics has launched a series of recent upgrades to its homepage at www.pcb.com, developed to help customers find the best sensor and instrumentation products for their application.

The PCB homepage offers a new look that includes varying images of typical applications, and a new, intuitive user search capability. This new interface allows the user to search by model number, product type and measurement type, from a database of more than 2500 sensors, signal conditioners, cables and accessories, with up-to-the-minute, fully downloadable,specifications and drawings.

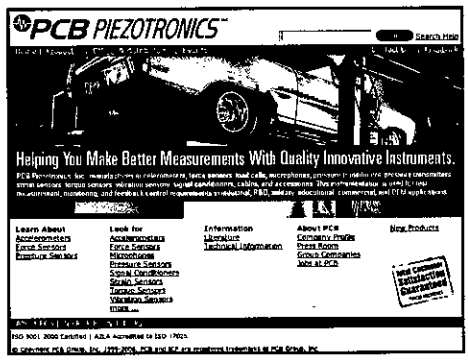
Founded in 1967, the company is a dominant player in the design and manufacture of force, torque, load, pressure, acoustic and vibration sensors, as well as the pioneer of ICP® technology. Core products include piezoelectric, piezo-resistive, TEDS, strain gauge and capacitive sensor devices. With 24-hour customer service support, direct sales offices throughout Europe and Asia and an established global distribution network, PCB attributes its continued growth to a commitment to total customer satisfaction.

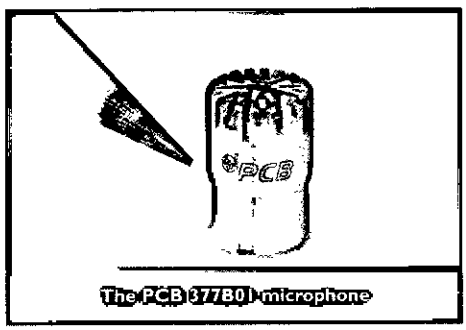
The vibration division has recently introduced the Model 377B01 prepolarised, one-quarter inch free field response-type microphone which operates from ICP sensor power. The distinguishing feature of this model is its enhanced frequency rating of 90kHz (±2 dB.) It has a sensitivity rating of 3 mV/Pa and a wide dynamic range of 30 to 166 dB(A). This microphone has a 120°C operating temperature range.

It is one of a full series of modern, pre-polarised, condenser microphones and preamplifiers available from PCB. Powered by a 2 to 20 mA signal conditioner and standard coaxial cables, the design allows for significant savings in power supply and cabling cost, greater ease of use and operates from the same power source as ICP® accelerometers.

For additional information, contact the Vibration Division of PCB Piezotronics, Inc. on **+001 716 684 0001**;
E-mail: **vibration@pcb.com**;
or fax on **+00(1) 716 685 3886**.

For other PCB products, contact PCB directly on **+00(1) 716 684 0001**, or visit the web site at **www.pcb.com**





Brüel & Kjær

Support for I-Deas Test Products

Brüel & Kjær has entered into a partnership with the Canadian software development company Maya HTT to become the exclusive sales and support channel for key NVH software products and active software maintenance contracts recently acquired by Maya HTT through its purchase of MTS Corporation.

This news will be welcomed by MTS customers following the company's decision to withdraw from the noise, vibration and harshness market. The new partnership is committed to continuing the sales and support of I-Deas Pro and related software products for noise and vibration analysis, serving new and existing customers for products previously owned by MTS through a well-established global network.

The accelerating time-to-market expected by vehicle manufacturers is transforming the way the world engages with NVH problems, according to Brüel & Kjær's Managing Director Karl Kristian Hvidt Nielsen. Brüel & Kjær was at the centre of this trend, and the I-Deas test products were a perfect supplement to the PULSE software and hardware platform. I-Deas Pro already had measurement support for Brüel & Kjær PULSE acquisition hardware, and data can be acquired and shared between the two products. With this fully integrated solution they were in the best position to redefine the way engineers and businesses tackled noise and vibration issues.

Maya HTT of Montreal, Canada was founded in 1982 and specialises in engineering software development and associated services. Working with its strategic alliance partner UGS, Maya HTT has an installed software base of 4000 users. As an experienced I-Deas product developer, and with an expanded development team, the company will complete all software development activities on the acquired MTS products to ensure that future product maintenance needs and market-driven enhancements are provided in releases closely aligned with the UGS I-Deas and Brüel & Kjær product strategies.

Brüel & Kjær assumes responsibility for all technical product support, and its global support network will be expanded with additional qualified personnel experienced in the MTS NVH product lines. For many years a distributor of I-Deas Pro and related products in Japan, Brüel & Kjær is well prepared to provide such support.

The company will work directly with customers to understand their current situation and assist them in meeting their future requirements with a combination of the acquired product lines, the extensive PULSE product family and associated accessories. MTS users will be contacted directly to provide new contact information for technical and sales support, and any specific questions will be welcome. Alternatively, users can e-mail **I-deas@bksv.com** asking to be contacted by a representative assigned to their geographical area.

Brüel & Kjær is a subsidiary of UK-based Spectris plc (**www.spectris.com**), which had sales of £650m in 2005 and employs around 5900 people in its business units.

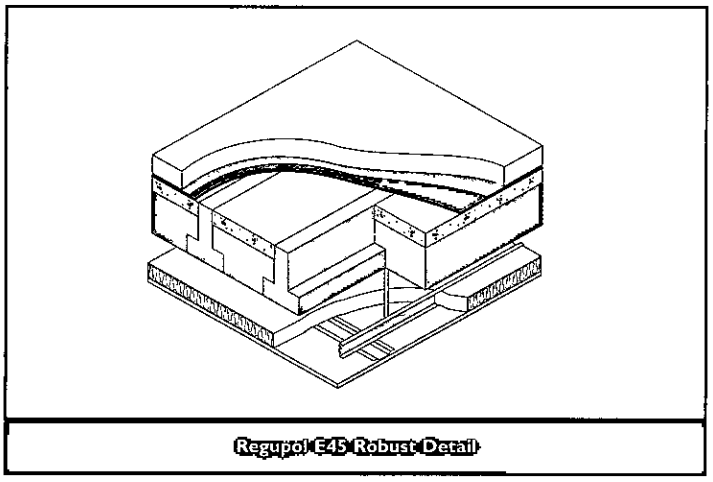
For further information contact
Rebecca McCullough, Marketing Coordinator,
Brüel & Kjær UK Limited,
tel: **01438 739000** fax: **01438 739099**
e-mail: **ukinfo@bksv.com**
web site: **www.bksv.com**

Regupol E48

Achieves first Robust Detail for AD-E compliant beam and block floors

CMS Acoustic Solutions Ltd has brought to market the first Robust Detail (RD) system for beam and block floors (E-FC-6). The approved system uses Regupol E48, an under screed impact reducing material. The RD was published at the end of March, enabling developers to return to the industry's preferred construction.

CMS Acoustics has worked with Regupol manufacturer BSW and the Beam and Block Federation to achieve the robust detail approval. As a proprietary system Regupol E48 is only available through CMS Acoustics. The beam and block component of the detail is generic, allowing E48 to be used with all types of the floor construction.



Regupol E45 Robust Detail

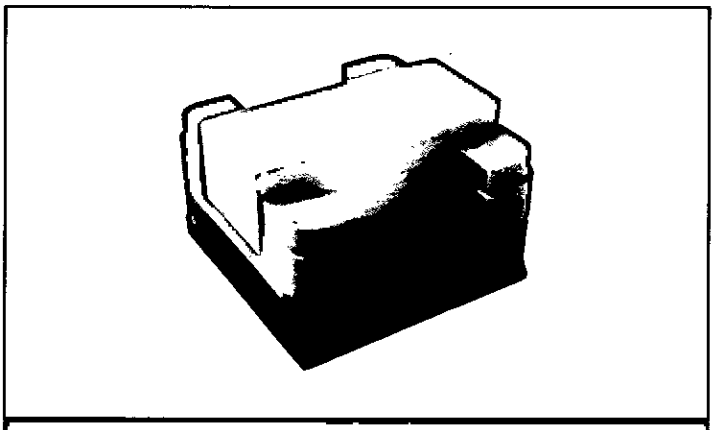
Jamie Symons, BSW UK managing director, commented that beam and block floors had shorter lead times than pre-cast floors, and were much less labour intensive. By delivering an RD approved system with Regupol E48, developers who favoured the RD route had the option to use the floor construction they wanted, and could be confident that it would be Part E compliant.

Regupol E48 is compatible with all types of floor screed and is suitable for use in most new build constructions. A simple fitting procedure ensures that the material is quick and easy to install. The system provides a typical impact sound transmission value 49dB ($L'_{nT,w}$), exceeding the requirements of Approved Document E.

Dave Baker, chief executive of RDL, said that the latest robust detail provided the house building industry with a new option for separating floor constructions, not previously covered by the RD scheme, and made Robust Details an even more attractive proposition for developers across England and Wales. The new system was expected to be particularly useful on small developments or tight sites, and would be of particular interest to small and medium sized builders.

Where pre-completion testing is preferred to RD, CMS Acoustics can also provide Regupol 7210C, a material intended as under screed impact sound insulation for hollow core beam and pre-cast applications.

The company has also launched SoundCradle, a new AD-E compliant impact sound insulation method. Approved for Robust Detail (RD) Type FFT2, the unique cradle and batten floor system can be built up to a maximum height of 540mm. It uses recycled, sustainable and standard building products, making it environmentally sound and cost-effective. It can be used with a wide range of voids, and offers a cost effective solution to what can sometimes be a challenging acoustic problem. SoundCradle is easily adjustable to accommodate various service requirements, including uneven floor surfaces and stairs. A combination of cradles and timber supports provides a system that is simple to install under raised floors. The unique interlocking cradle design also enables a wide range of void depths to be achieved.



AD-E Compliant SoundCradle

The product is approved for use with RD floor construction types MF1 (E-FC-1), MF8 (E-FC-2) and SF2 (E-FS:1), and is ideal for use with pre-cast and beam and block floors.

Manufactured in Germany by BSW, the complete Regupol range is available exclusively in the UK through CMS Acoustics. The company has an enviable record of introducing new products aimed at AD-E compliance.

The CMS Acoustics Group also includes CMS Vibration Solutions, which specialises in anti-vibration and structural isolation products for construction and industrial applications. Through partnerships with manufacturers of market leading systems, it has access to a full range of anti-vibration and structural isolation products.

For further information visit **www.cmsacoustics.co.uk** or call **01925 577711**.

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Lafarge Plasterboard

New education sector manual

Lafarge Plasterboard has published a new Education Sector Specification Manual, providing comprehensive answers to the specific design challenges of Building Schools for the Future, focusing on acoustic performance, impact, fire resistance, build and whole life costs.

The manual includes a useful guide to regulations and design considerations to assist specifiers, architects, designers and main contractors in ensuring appropriate solutions are adopted for partitions, floors and ceilings in educational buildings.

In addition to the manual, the Lafarge enquiry line and the team of Lafarge technical specification managers are available to provide support on education projects.

Copies of the manual can be obtained by contacting the Lafarge plasterboard literature line on **01275 377582**.
The information contained in the manual is also available at **www.lafargeplasterboard.co.uk**

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Applications for Sponsor Membership of the Institute should be sent to the St Albans office. Details of the benefits will be provided on request.

Committee Meetings 2006

DAY	DATE	TIME	MEETING
Tuesday	9 May	10.30	CCWPNA Examiners
Tuesday	9 May	1.30	CCWPNA Committee
Thursday	11 May	10.30	Membership
Wednesday	**17 May**	**4.45**	**Annual General Meeting (London)**
Thursday	25 May	10.30	Publications (St Albans)
Thursday	8 June	11.00	Executive (St Albans)
Tuesday	13 June	10.30	CMOHAV Examiners (St Albans)
Tuesday	13 June	1.30	CMOHAV Committee (St Albans)
Tuesday	20 June	10.30	CCENM Examiners (St Albans)
Tuesday	20 June	1.30	CCENM Committee (St Albans)
Thursday	**22 June**	**11.30**	**Council (St Albans)**
Thursday	29 June	10.30	Distance Learning Tutors WG (St Albans)
Thursday	29 June	1.30	Education (St Albans)
Thursday	6 July	10.30	Engineering Division (St Albans)
Tuesday	11 July	10.30	ASBA Examiners (St Albans)
Tuesday	11 July	1.30	ASBA Committee (St Albans)
Tuesday	8 August	10.30	Diploma Moderators Meeting (St Albans)
Thursday	7 September	10.30	Membership (St Albans)
Thursday	14 September	11.00	Medals & Awards (St Albans)
Thursday	14 September	1.30	Executive
Thursday	**28 September**	**11.30**	**Council (St Albans)**
Thursday	5 October	10.30	Diploma Tutors and Examiners (St Albans)
Thursday	5 October	1.30	Education (St Albans)
Thursday	12 October	10.30	Engineering Division (St Albans)
Thursday	19 October	10.30	Publications (St Albans)
Thursday	2 November	11.00	Research Co-ordination (London)
Tuesday	7 November	10.30	CCENM Examiners (St Albans)
Tuesday	7 November	1.30	CCENM Committee (St Albans)
Thursday	9 November	10.30	Membership (St Albans)
Tuesday	14 November	10.30	ASBA Examiners (St Albans)
Tuesday	14 November	1.30	ASBA Committee (St Albans)
Thursday	16 November	10.30	Meetings
Thursday	23 November	11.00	Executive (St Albans)
Tuesday	5 December	10.30	CMOHAV Examiners (St Albans)
Tuesday	5 December	1.30	CMOHAV Committee (St Albans)
Thursday	**7 December**	**11.30**	**Council (St Albans)**
Tuesday	12 December	10.30	CCWPNA Examiners (St Albans)
Tuesday	12 December	1.30	CCWPNA Committee (St Albans)

Light refreshments will be served after or before all meetings. In order to facilitate the catering arrangements it would be appreciated if those members unable to attend meetings would send apologies at least 24 hours before the meeting.

Conferences & Meetings

Diary 2006

5-7 May 2006
The Sixth International Conference on
Auditorium Acoustics - Copenhagen, Denmark

15 May 2006
North West Branch
Handling Complaints about Low Frequency Noise - Salford

17 May 2006
Measurement and Instrumentation Group
HARMful - judge for yourself! - London

23 May
Environmental Noise Group
Developments in Noise Research - Birmingham

11-12 September
Underwater Acoustics Group
International Conference on Synthetic Aperture Sonar and Synthetic Aperture Radar - Lerici, Italy

26 September
Electroacoustics and Measurement & Instrumentation Groups
Intelligible Measurements! How accurate are speech intelligibility measurements in practice? - London

16-17 October
Environmental Noise Group
Autumn Conference 2006 - Oxford

3-4 November
Electroacoustics Group
Reproduced Sound 22 - Oxford

10-12 April 2007
Underwater Acoustics Group
4th International Conference on Bio Acoustics - Loughborough

Further details can be obtained from
Linda Canty at the Institute of Acoustics Tel.: **01727 848195**
or on the IOA website: **www.ioa.org.uk**

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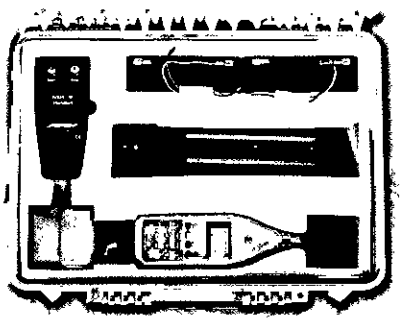

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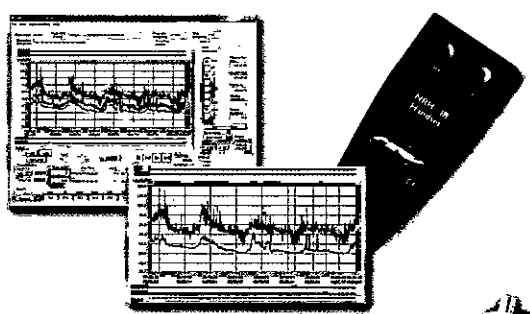

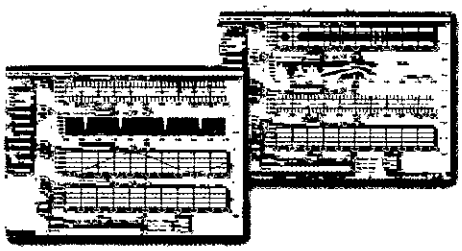

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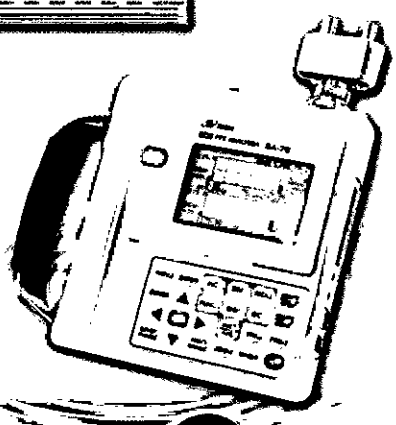

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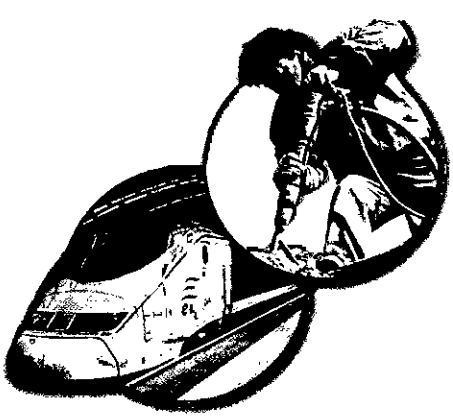

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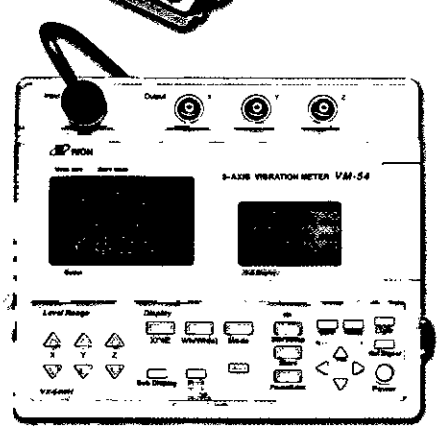

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