



Institute of Acoustics

Acoustics and Europe

The Copenhagen Conference

Ian H Flindell MIOA

Technical Contribution

The Changing Face of Instrumentation for
Environmental Noise Monitoring

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The Acoustics World

Standards for a Quieter World:

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Engineering Council – Quarterly Report September 1998

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Volume 23 No 5
September – October 1998

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Street, St Albans, Herts. AL1 3BN

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e-mail Acoustics@clus1.ulcc.ac.uk

Web site <http://ioa.essex.ac.uk/ioa/>

Printed by:

Unwin Brothers Ltd, UBL International,
The Gresham Press, Old Woking, Sur-
rey GU22 9LH.

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Single copy £13.00 Annual subscription

(6 issues) £75.00

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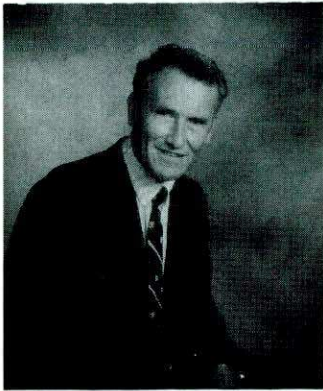
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Dear Fellow Member

Thanks for reading Acoustics Bulletin, although this is just one of our publishing ventures it is probably the one that members look to for news and topical information. It has in many respects become the newspaper of the profession. Information on our conferences and seminars, activities of the specialist groups, meetings of the local branches and of course employment opportunities form the backbone of the topical information that we need to communicate to the membership. To help provide this information in a timely fashion we are now putting it onto our web site so that it will be always available and up to date. Our site can be found at the following address: -

ioa.essex.ac.uk/ioa/

To date the site has been maintained on a voluntary basis by Mark Tatham and his efforts are much appreciated. He is now working with the Bulletin Management Board to put the site onto a more professional basis and to help us achieve that we would all welcome feed back from users. Please visit the site and let us have your comments and observations.

Another new publishing venture for the Institute is a Buyers' Guide to Acoustic Instrumentation, Accessories and Acoustic Products. The project is the brainchild of Keith Rose who is the Associate Editor for the publication. It is being published as a companion volume to the Register of Members in the late autumn of this year. The intention is to make it as comprehensive as possible but it can only be as good as the inputs we receive. When you get your copy, please tell us what is good and bad about it and we can take these points into consideration for the subsequent issue.

No general review of the Institute's publishing activity would be complete without a mention of our formal Proceedings. These document all our formal technical meetings and conferences and form a unique reference to the state of the art in acoustics, the support of those technical libraries that make them available to researchers is much appreciated. For those who require to publish their work in a formal refereed journal our co-operation with the European Acoustics Association gives a route to Acta Acoustica.

*With kindest regards, I remain
Yours truly*



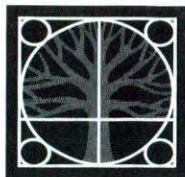
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THE COPENHAGEN CONFERENCE ON THE EU'S FUTURE NOISE POLICY – THE FRAMEWORK DIRECTIVE ON ENVIRONMENTAL NOISE

Ian H Flindell MIOA

Introduction

On September 7th and 8th, 1998, the European Commission's General Directorate for the Environment (DG XI) and the Danish Environmental Protection Agency hosted a key conference on the EU's future noise policy in Copenhagen for around 200 invited delegates. There were 27 delegates listed from the UK, plus Brian Hemsworth from the UK but representing the European Rail Research Institute in Utrecht. The main objective of the conference was to further the Commission's new policy, as first set out in the Green Paper published at the end of 1996, by dissemination, involvement and commitment of invited 'Noise Professionals' from across the whole of Europe.

The conference was organised in such a way as to create a very clear impression that the Commission, supported by the Danish EPA, are now absolutely serious in their intention to make positive progress in the field of environmental noise. The plenary sessions were held in the magnificent main hall of the Borsen, the old Royal Stock Exchange, which was built by King Christian 4th between 1619 and 1624. Parallel working group sessions to discuss five main aspects of the new Framework Directive on Environmental Noise were held just around the corner in the Christiansborg, the Danish Parliament Building. In the UK, this would be equivalent to holding the conference in the House of Lords and adjacent committee rooms at Westminster.

Keynote Speeches

Keynote speeches by the great and the good occupied the first morning of the conference. The speakers were; Mr Svend Auken, the Danish Minister for the Environment and Energy; Ms Ritt Bjerregaard, the EU Commissioner for the Environment; Mr Jens Kramer Mikkelsen, the Lord Mayor of Copenhagen; Mr Domingo Jimenez-Beltran, Executive Director of the European Environment Agency; Mr Christian Popp, Vice President of the German DAL (representing the European Environment Bureau); and Mr Hans Jurgen Stehr, Head of Division of the Danish EPA. The delegates were left in no doubt that environmental noise has suddenly moved much nearer the top of the political agenda. Copenhagen itself was put forward as a good example of how environmentally friendly transport policies can contribute to a noticeably quieter ambient noise climate as compared to a typical British city of a similar size. Taxes on private cars are very high, and most people seem to use bicycles.

The Framework Directive

After lunch in the Christiansborg, Prudencio Perera, Head of Unit, DG XI/D/3 and Tjeert ten Wolde from the same unit set out the recent history of the Commission's policy on noise. After reviewing around 400 responses to the 1996 Green Paper, the Commission decided to press ahead with the development of the Framework Directive in two stages, which can be broadly summarised as follows;

Step 1 (to be finalised before the 1999 summer break)

- Define harmonised noise indicator(s) for the main environmental noise sources. These indicators to be adopted immediately except where Member states already have existing indicators in place, in which case there will be a transitional period of 3 years from the date of the directive.
- Commence noise mapping of cities with more than 250,000 population, and provide the resulting information to the public.
- Develop action plans for future noise reduction against possible targets.
- Contribute to a European noise data bank to be set up by the EEA (European Environment Agency).

Step 2 (to be finalised in 2002 or 2003)

- Extend the adoption of harmonised noise indicators to all environmental noise sources.
- Adopt fully harmonised mapping based on harmonised computation and measurement methodologies.
- Further increase the flow of information to the public.
- Possibly work towards common European environmental noise target values.

DG XI see the adoption of harmonised indicators, computation, mapping, and measurement methods, and possibly even harmonised target values, as key components of their overall strategy. DG XI acknowledge the existence of a number of what are seen as predominately industry dominated working groups (WGs) which have agreed type approval noise limits for road vehicles, aircraft and certain types of machinery used outdoors, but they now wish to bring these under more strategic control with additional WGs to deal with the perception of noise, with future research and with costs. The overall aim is to emphasise the effect that any future noise control actions might have on aggregate residential exposure, rather than simply concentrating on the technical feasibility of actions taken at the source. DG XI see the present fragmentary and widely disparate approaches to the mon-

itoring of exposure in different Member States as a significant weakness in their overall plans.

The Five Technical WGs

Five technical WGs were set up to provide specific advice to the Commission under terms of reference agreed at a preliminary meeting in Brussels on the 15th June. Each WG is funded for travel and similar expenses on a shared cost basis by the Commission and chairman's Member State, although there seems to be some doubt as to the extent to which the full costs incurred by other members of each WG will be met under these arrangements. 'Shared cost' often seems to work to the benefit of the Commission. The five technical WGs are as in Table 1.

An additional WG on costs and benefits has been under discussion for some time but has not yet been established. To some extent at least, the published terms of reference for this WG overlap with the existing WG5, although it would seem important that the economic consequences of any actions taken should be fully appreciated in advance.

The Commission selected between 9 and 12 members for each technical WG from nominations made by Member States. Considerable care was taken to obtain a representative balance between different Member States and different interest groups and because of this, a number of nominees were not selected by the Commission. One of the key objectives of the Copenhagen conference was to seek additional views and comment from other individuals not directly involved in the actual WGs.

An overall Steering Committee with a single representative from each Member State will meet for the first time in December 1998 to co-ordinate the work of the individual WGs and to provide feedback at the earliest possible stage about Member State requirements. This is because individual members of the technical WGs are not expected to represent their particular Member States or any other constituency but merely to contribute as best as they can on an individual basis. The UK representative to the Steering Committee will probably be Martin Joseph from the DETR.

Of major interest is the Research WG which will first

meet some time after the Copenhagen conference to consider suggestions made by each of the technical WGs for new research required in support of the directive. It is expected that some of the funding for this new research will be made available under the 5th Framework Programme which expects to have around 16,000,000,000 ecu available in total (of this sum, around 900,000,000 ecu might be expected to be made available to support noise research). Member States are also requested to advise the Commission of any nationally funded research they have in place, or may be able to support over the next few years.

WG1, Indicators, is expected to report around the end of this year (1998), so that the recommendations can guide the work of all other WGs. Immediately after a plenary presentation by Martin van den Berg and the writer about the immediate tasks before WG1 (which had already met three times before the conference) parallel sessions of each technical WG were held in the late afternoon of the first day, continuing up until lunchtime on the second day. Each technical WG chair then made a short presentation on the final afternoon about progress made and future plans.

WG1 Indicators (parallel workshop session)

Having previously reported in the plenary session on the Dutch Health Council proposals for a relatively complex single number indicator based on L_{Aeq} with adjustments for time of day, acoustic features, and type of noise source, Martin van den Berg described the general consensus in WG1 towards using the A-frequency weighting for standard situations, with the possibility of unweighted and frequency spectrum measurements for use where it is necessary to take extreme frequency components into account or to contribute to the detailed design of engineering noise control measures. This consensus was almost unanimous except for one contributor to the parallel session who preferred the D-weighting for aircraft noise. Of course, if this suggestion were to be adopted, the whole principle of supporting strategic comparisons between different noise sources would be seriously undermined. A key principle seems to be that all noise sources should be treated alike.

There was convergence on the specification for the standard reference receiver point, provisionally based on free-field conditions. The general intention was that the effect of all topographic features intervening between source and receiver would be taken into account with the exception of any vertical and horizontal reflecting surfaces within 3 to 4 metres of the

	Title	Chair	Co-chair
WG1	Indicators	Martin van den Berg Netherlands	Ian Flindell United Kingdom
WG2	Dose-Effect	Jacques Lambert France	Birgitta Berglund Sweden
WG3	Computation and Measurement	Dieter Gottlob Germany	Jorgen Kragh Denmark
WG4	Noise Maps	Catherine Boulard Belgium	John Hinton United Kingdom
WG5	Abatement	Sirkka Paikkala Finland	Werner Talasch Austria

Table 1 The 5 technical WGs

defined receiver position. Where measurements closer to vertical façades are unavoidable, then the effect of façade reflections would have to be taken into account in any observed differences from the defined reference conditions.

Long term rms averaging (L_{Aeq}) was preferred despite reservations by some contributors to the workshop session. There was a consensus that night-time noise required separate definitions and indicators, but no conclusions were reached on similar proposals for separate indicators for the evening period. Noise complaints were considered to be an important source of information regarding possible noise problems as they arise, but the prediction of individual complaints was considered to be outside the scope of any methods that might be included in the directive.

The main issues discussed in the WG1 workshop session were reported as being the feasibility of including industrial noise and acoustic features within the scope of the indicators recommended for the first step directive in 1999; the possible uses of L_{Amax} and the best types of indicators to use for night noise. Practicality and implementation were not discussed in the parallel sessions and would be considered separately by WG1.

WG2 Dose-Effect (parallel workshop session)

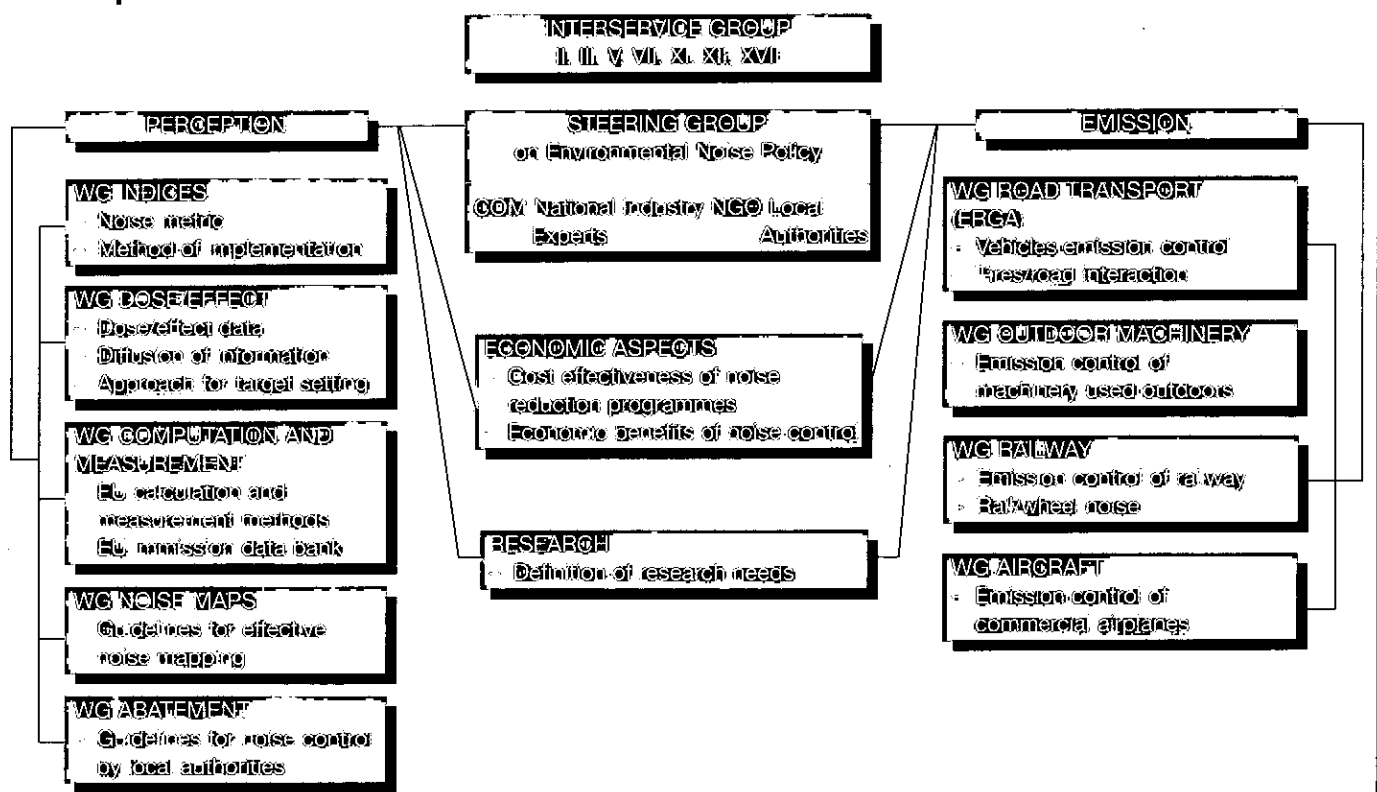
Jacques Lambert reported on progress made in what was effectively the first meeting of WG2. The terms of reference require it to *elaborate a set of relationships between noise exposure (dose, in terms of an agreed indicator) and the effects of the noise.... this shall be*

done for separate types of noise. DG XI's intention is that recommendations made by WG2 shall contribute to the interpretation of different amounts of noise as shown in terms of the indicators recommended by WG1, and there is an obvious overlap between the tasks of the two WGs. The first draft of the WG2 position paper had already been prepared in outline form and is really only a list of chapter headings at the present time. Between 25 and 35 separate research topics were suggested in the parallel session, needed to overcome the present considerable uncertainty regarding the precise exposure/effect relationships which may or may not exist in many areas. Bernard Berry from the National Physical Laboratory represents the UK in WG2.

WG3 Computation and Measurement (parallel workshop session)

Dieter Gottlob reported on progress made in WG3. There are clear intentions to separate the source description and propagation modelling components in any noise calculation scheme, with the propagation modelling further extended to take into account different frequency components and the effects of different meteorological conditions. Clear and precise definitions of the required outputs of the calculation procedure would be needed (a reference to WG1) given the vast range of possibilities that exist. There was recognition that a hierarchy of methods of increasing complexity might be required to deal with different situations as they arise. A question from the floor concerned the role of existing standards committees in bringing forward this type of work and this was answered by Tjeert ten Wolde who proposed that the rec-

European Commission: Action on Noise



ommendations of WG3 would be offered for standardisation in due course, rather than the other way round which would take too long. There was no debate on the relative advantages and disadvantages of computation and measurement, but these should of course be obvious to most readers. There were no UK representatives in WG3 at the time of the conference, but it is understood that Paul Nelson from the Transport Research Laboratory was subsequently invited to join.

WG4 Noise Maps (parallel workshop session)

DG XI appear to have a number of different views regarding the real purpose of noise maps. For simply presenting information to the public, they have a clear preference for maps of presumed noise effects. Since it is not feasible to directly measure the percentages reporting themselves as *highly annoyed* or suffering sleep disturbance over large areas, the obvious alternative is to calculate the percentage highly annoyed using an assumed exposure/effect relationship from computed noise exposure values. It would be fair to say that there is some considerable scepticism about this approach. Another alternative, which Catherine Bouland reported as being preferred by WG4, is to concentrate on maps of physical exposure only, if necessary using separate indicators for different noise sources so as to allow the possible effects of different noise control options to be seen more clearly. WG4 expressed some concern over the overlapping responsibilities between different WGs without expressing any clear ideas at this stage as to how this uncertainty could be overcome. It was clear that WG4 was only at the very beginning stage of its deliberations.

WG5 Abatement (parallel workshop session)

The stated function of WG5 is to *make guidelines to be used by local authorities for designing noise abatement plans and the execution of those plans*. WG5 is expected to make an inventory of existing noise control methods and given the vast amount of published reports and reviews on this subject, this task seems to be little more than an exercise in compiling information. However, judging by the progress report made by Sirkka Paikkala, her WG appears to be having some difficulty. Despite having had several months for negotiation and further clarification, Ms Paikkala expressed continuing reservations about the terms of reference for WG5. On the other hand, an exchange with Tjeert ten Wolde for the Commission gave a clear impression that WG5 had been unable to suggest alternatives, or even to specify precisely what they are unhappy about. Ms Paikkala was unable to answer even the simplest questions from the floor regarding the relative emphasis to be placed on noise control at source vs noise control along the propagation path. Since WG5 is not expected to report for some time, there is no immediate problem, but it will be interesting to see what happens in the future. There are no UK representatives in WG5 at present.

Closing Remarks of the Conference

The final presentations were given by officers of the Commission. Tjeert ten Wolde reported a new industry-based initiative to set up a Railway Noise WG, something that has been talked about for some time. He then reviewed the timetable for further progress. Per Kruppa, from DG XII, contributed an ad hoc report on the anticipated 5th Framework Programme which was now running behind schedule, and made a very clear request that new ideas for noise research should be brought forward for consideration at the earliest opportunity to have any chance of being included in the next programme.

Prudencio Perera, the main architect of the whole policy for DG XI, expressed clear satisfaction with the way in which the conference had gone and the way in which the delegates had contributed to the whole process. Prudencio explained that, owing to the current political situation within the EU and the EC, there was a clear window of opportunity for action, and that, as far as he was concerned, the Commission would take every step it could to make sure that this opportunity was not wasted.

Issues Arising

Unless there is a major shift in the political climate in Europe, the much anticipated Framework Directive will be adopted in 1999. By 2002, every Member State will be required to adopt the harmonised EU noise indicators. Our dearly beloved L_{10} index for road traffic noise, and the L_{90} for background noise, may become illegal. Local government will be obliged to publish noise maps for most urban areas and Member States will be taken to task for non-compliance with agreed noise control action plans. An extreme but possible interpretation of current EC plans could mean that residential outdoor exposure above say 55, 65, or 75 day-time L_{Aeq} might become illegal.

Although the precise details have yet to be worked out, the Commission's long term aims are the development of coherent noise policies across Europe, environmental measures that will improve every citizen's quality of life and improved conditions for health. In the Commission's view, this can only be achieved through the adoption of harmonised indicators of noise exposure and noise mapping and through the monitoring of action plans for strategic noise reduction against agreed targets. Everything has to be done in such a way that it can be easily understood by the public, such that if Member State A produces maps showing small percentages of residents exposed at the very highest target noise levels and Member State B does the opposite, showing much larger percentages of residents exposed above some much lower target noise level, then citizens will be able to form their own views of the relative priorities placed on noise matters by each Member State and vote accordingly. In the Commission's experience, Ministers of each Member State can be particularly sensitive to this type of statistical information.

The main technical issues seem to be as follows;

- What are the true costs and benefits of harmonisation for Member States, and for their citizens, of an enforced change from long established national procedures?
- Should maps (and indicators) really be based on assumed exposure/effect relationships with their underlying technical uncertainty, or should they be based on physical noise levels alone, if necessary broken down by each type of source so as to be able to show the precise benefits of possible noise control actions in physical terms?
- Should targets be expressed simply in terms of not-to-be-exceeded noise limits, or in terms of some aggregate reduction applying across the board at all levels of exposure, or just in terms of further tightening of type approval noise limits irrespective of any aggregate benefits that this might have for exposure or not?

In connection with WG1 Indicators, of which the writer is co-chair, the main technical issue seems to be whether the indicator should include adjustments for time of day, acoustic features, and type of source, as in the Dutch Health Council proposals, or whether each separate feature of relevance should be separately indicated in physical terms alone. The Dutch view seems to be that current uncertainty over the size of any adjustments required can be resolved with a little bit more research, but the alternative view, that some of these questions are not capable of being resolved by further research and that the Dutch are asking fundamentally the wrong questions, is gaining ground. The Commission's view seems to be that, providing that the indicators used can be understood by the public, then there is no objection in principle to the use of multiple indicators to represent day and night noise separately, broken down by separate sources as required. There is a clear precedent for this in the field of air quality, which the Commission is using as a model for their current efforts in noise control. On the other hand, Martin van den Berg, the chair of WG1, and Tjeert ten Wolde of DG XI, were respectively the chairman of and the adviser to the committee which produced the report on which the Dutch Health Council proposals are based. At various ad-hoc meetings held in the UK, a consensus seems to be emerging that the harmonised EC indicators should be of physical exposure alone, with the application of any essentially subjective adjustments to be left as a matter for individual Member States if they so choose.

By constructively engaging in the whole process, the UK is much better placed to have a significant influence on the eventual outcome. The alternative anti-European stance which can still prevail in the UK would in this case be likely to be counter-productive as the Framework Directive can be adopted by majority voting whether the UK agrees or not. Anyone that might want to retain the L_{10} and the L_{90} for sentimental reasons alone is probably going to be disappointed whatever happens.

Ian Flindell MIOA is at the Institute of Sound and Vibration Research, University of Southampton ❖



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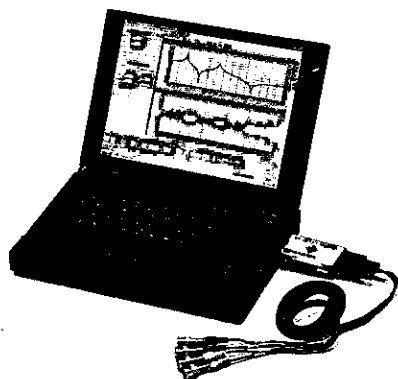


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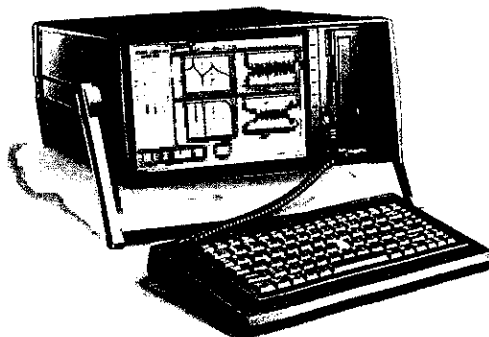
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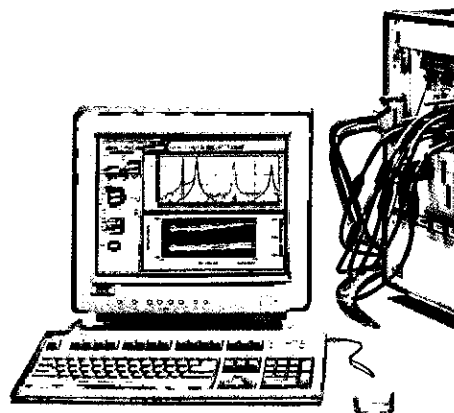
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THE CHANGING FACE OF INSTRUMENTATION FOR ENVIRONMENTAL NOISE MONITORING

Richard Tyler FIOA

Introduction

Twenty years ago, instrumentation for monitoring environmental noise fell fairly neatly into two groups. The first was designed for permanent installation (or semi-permanent), whilst the second was fairly portable and expected to measure for about 1 – 7 days. All these solutions were moderately expensive, and as sound level meters started to include many of the measurements required for environmental noise monitoring, repackaging these into weatherproof cases heralded the demise of many of their predecessors. With computer based instrumentation now becoming commonplace in many instrumentation aspects, will history repeat itself? This article looks at the information required from the instrumentation and discusses what has been collected in the past and how this will best be achieved in the future.

The First Dedicated Environmental Noise Analysers

Where a permanent public power supply is available, and the cost of supplying this power acceptable, it has been possible to provide environmental noise monitoring to a reasonable standard for at least the last 40 years. However, the biggest increase seen in required data started in the 1970s when the combination of legislation and transistor technology made portable noise monitors available that could achieve reasonably long measurement intervals from internal battery supplies. An early example of this was the CEL-162, (see Figure 1), which offered measurement of sound pressure level and equivalent continuous level (L_{eq}) with results logged in periods selected by the user and reported by an in-built printer that was the only non-volatile storage available. The data gathered had to be manually transcribed to whatever and wherever the user required, and could not be re-analysed – mistakes in setting the instrument meant remeasuring the noise. This package proved popular, especially so in the UK where local authority officers could leave the box locked up and secured to suitable devices such as lampposts, go away and do other work, then return at the end of the measurement period to collect the complete data.

This approach continued into the 1980s with more refined instrumentation, packaged in weatherproof housings, and with an ever-increasing array of parameters deemed 'useful' for describing various environmental noise nuisances. Dynamic ranges

increased, often being around 90 – 100 dB when sound level meters were still only able to offer 50 – 60 dB, and the sound levels were now analysed using a statistical approach, often referred to as L_n where 'n' was the percent of the measurement time that the reported level was present or exceeded. Fixed time intervals for reporting were greatly increased in range, so that it was possible to get a 1 minute measurement of L_{eq} every minute for the whole of a 24 hour period, or produce statistics on the noise climate every 10 or 15 minutes. As non-volatile semiconductor memory was still expensive and limited in capacity, the printer continued to be the source of all data available from the instruments, with many ingenious devices added to gather the printed results within the environmentally protected enclosure.

During this time, permanent noise monitoring moved to embrace telephone connection, and modems were added to what were little more than environmentally protected sound level meters, so that the measured data could be sent to a remote location for analysis. The amount of data sent and the ability of the receiving equipment to report on this data varied widely but, by the mid-1980s, small computers with the ability to communicate continually with the noise monitoring equipment via a line of some description were being used to take frequent noise readings (say once or twice a second), and use the storage and processing capabilities of the computer to measure and save the parameters the user was particularly interested in. Reports could be prepared on this computer and printed out in the required format to whatever printers the computer supported.

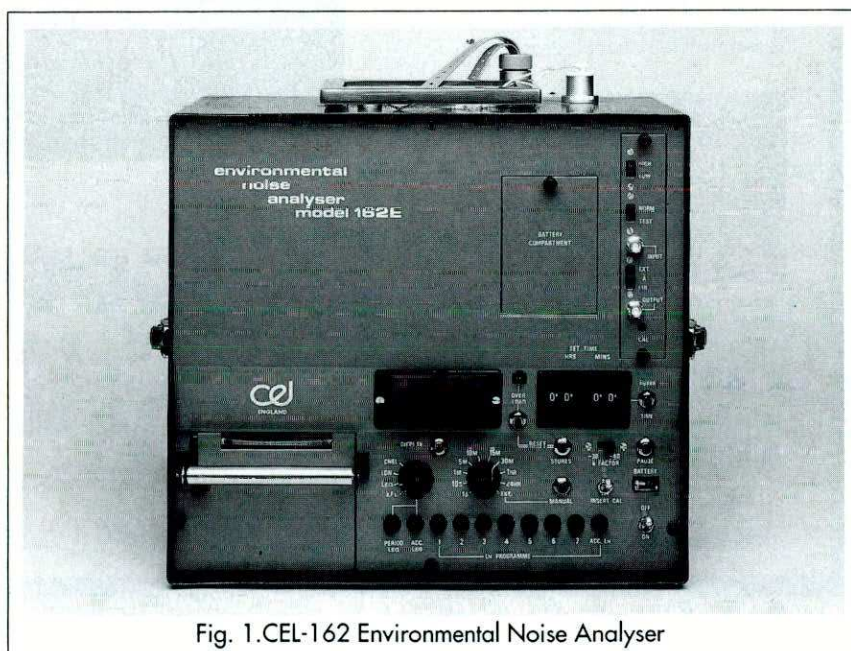


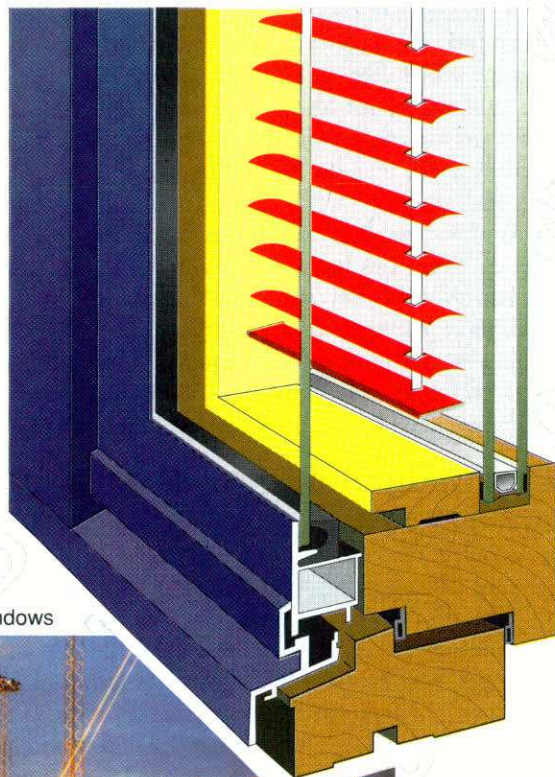
Fig. 1. CEL-162 Environmental Noise Analyser

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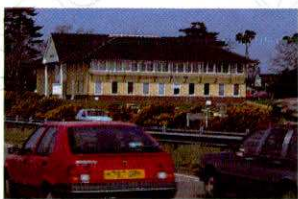
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Convergence of Noise Monitoring Instrumentation

The increasing availability of portable computing power that developed in the 1980s made dramatic changes to the possibilities for environmental noise monitoring. Inbuilt microprocessors and the reduced cost of memory saw sound level meters that started to have pre-determined measurements suitable for environmental noise monitoring saved to non-volatile semiconductor memory inside the meter on a periodic basis, and offered for sale at less than half the price of the dedicated environmental noise analyser. However these meters were not environmentally well protected or easy to secure, and this led to some interesting approaches by users. Possibly one of the most unfortunate was the case where the meter was to be left for a few days unattended, so in order to reduce the likelihood of theft, the meter was wrapped carefully in a polythene bag, stuck up with tape and buried 30 cms underground, with just the microphone cable protruding. This may have been satisfactory but for the fact that the next day 15 cms of snow fell, making access to the site impossible. A rapid thaw changed the area into a lake, so that by the time the equipment could be recovered, it had effectively been immersed in water for about a week. The economic advantages of the packaging of environmental noise analysers was amply demonstrated. However, the idea of reducing equipment costs by using an ordinary sound level meter and giving it suitable environmental protection soon looked attractive to many government and local authority users who were increasingly being asked to measure more with decreasing budgets. Home-made solutions gave way to engineered packages from manufacturers using ranges of environmentally sealed cases, mostly in briefcase or attaché case form, that could have weatherproof connectors mounted on them to enable all external connections to be watertight, and which had locking systems that enabled both the case to be locked and to be secured by chains or wires to some permanent feature of the landscape.

At the same time as this was occurring, electronic communications were also improving rapidly. This led to the existing environmental noise analysers adding RS 232, IEEE 488 and a variety of modems in with the hardware, and adding non-volatile solid state memory, usually as an addition to the printer. This meant that these analysers could do more than the previous permanent noise monitors, gave the flexibility to store data temporarily prior to transmission to another location, and were available for moving from location to location as required. The CEL-262, fitted with its solid state storage (known as the Datalid because

it was an add-on option sited in the lid of the instrument), RS 232 and IEEE bus connections represented the typical development of this type of instrumentation (see Figure 2). However, with the exception of the radio link modem, which was not very common in the late 1980s, the need for a permanent telephone line to the site made applications for this instrumentation limited. The lower cost of the sound level meter approach, despite the need to go to the noise monitor each time data was required, found increasing favour with users and eventually led to the demise of much of the dedicated equipment as sales fell to unsustainable levels.

In 1998, many manufacturers continue to offer logging sound level meters enclosed in environmentally protected carrying case systems, often with space for DAT recorders and large batteries, as the standard portable and semi-permanent environmental noise monitoring kit. Data can usually be downloaded to a computer when the equipment has completed its measurements. Figure 3 pictures a typical system.

What Role for the PC?

At the start of the 1990s, a number of manufacturers were offering the possibility of connecting a microphone to a small box of electronics that in turn linked directly to a PC. The PC became the control, display and storage of the 'instrument', as well as its communications system. Some attempted to remove the small box and replace it with a standard sound card, and if this was incorporated into a laptop computer, a portable measuring system became just a microphone and the appropriate computer parts. However, there was no easy way to make this weatherproof or theft resistant, and the variability of sound cards soon led to most quality systems retaining the external box of electronics. The advantage this approach has is obvious – the PC can be used for all

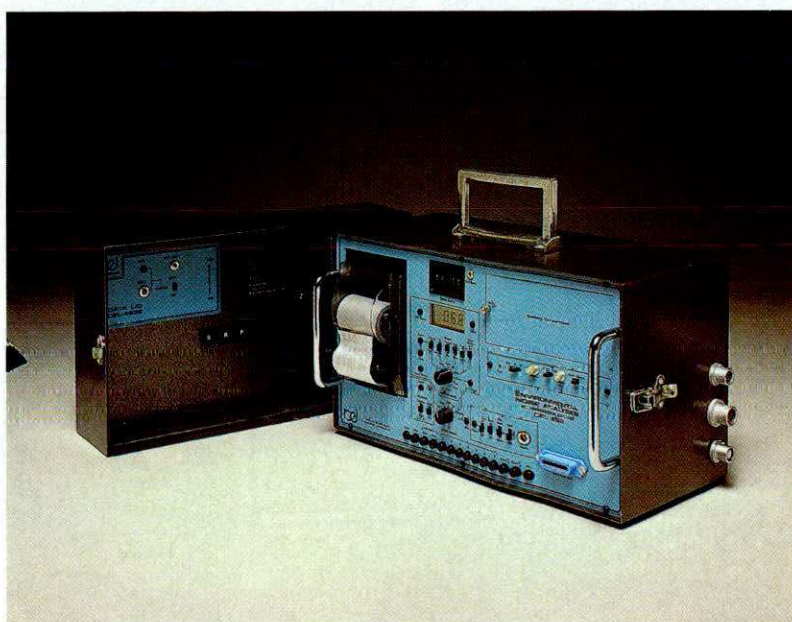


Fig. 2.CEL-262 Environmental Noise Analyser

manner of other tasks and the user only has to purchase the 'front end' of the system plus the appropriate software. For instrument manufacturers this changes the bias of the design effort. Whereas with a portable self-contained instrument, the designer had to create the entire package of measurements, controls and displays, but was free to optimise all areas to suit the task in hand, with a PC nearly all the operational capabilities, controls and display styles were preset. They had to be manipulated as well as possible to achieve an acceptable end result. The design emphasis becomes focussed to a much greater extent on writing software, and often as much time is spent finding ways round certain features of PCs that are not conducive to good instrumentation practice as in writing the required instrument features. Often the most important of these is timing. Ensuring that the measurements taken are complete and correct within the measured time interval is notoriously difficult if the programme is running under Windows, as the multitude of background tasks available make external communications a task to be attended to as and when computing time permits!

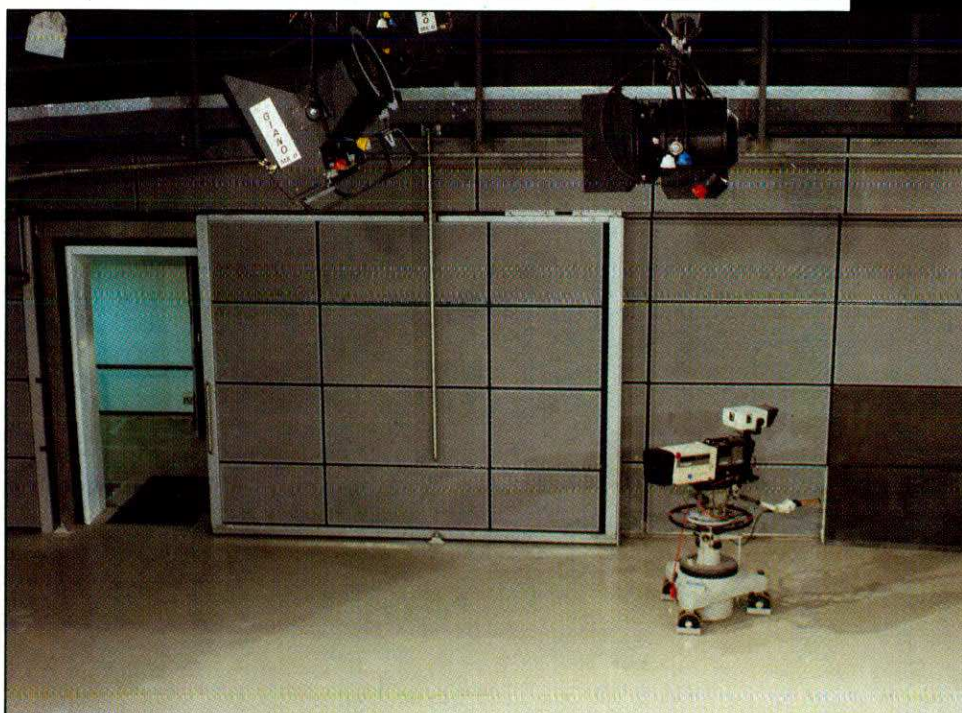
If the microphone signal is input directly, or near-directly, into a computer, several features of standard sound measuring equipment are difficult to achieve. Firstly, there is the question of measurement dynamic range. Most instruments have a range control that amplifies or attenuates the signal before entering the real measurement chain. If this is required, as it usually is, the means of range changing must also be computer controlled if the system is to know what range of signals to expect.

Almost every outdoor noise measurement is made using the A-weighting. Although Digital Signal Processing techniques can produce an A-weighted signal by mathematical processing, doing this on the average PC in real time over a 20 kHz bandwidth is extremely computing-intensive, and therefore having the A-weighting performed by dedicated electronic circuitry saves a huge amount of computing time. Even if the dynamic range and A-weighting are realised external to the PC, a good quality system will need to take at least 40,000 samples per second to describe fully the complete audio frequency response.

This produces an awfully large number of data points which by themselves are not usually required. Some form of data reduction to produce a lower data rate of say Sound Pressure Level and Equivalent Continuous Level (L_{eq}) will reduce the demands on the PC by several orders of magnitude. If these two parameters are available at say 20 readings per second, almost all descriptors used for environmental noise monitoring could be adequately constructed by the PC from these two pieces of raw data.

This is, in essence, what many noise monitoring terminals and sound level meters with real-time digital outputs actually are capable of producing, but few are optimised in this way. However, these parts are all available ready for outdoor use. If a suitable microphone with basic processing electronics is linked to a PC with a matching analysis software package, almost all required measurements can be obtained and saved on the PC.

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Fig. 3. A typical system in 1998

Does a PC Suit Environmental Noise Monitoring Requirements?

These systems just described, as they cannot really be called an instrument, have found many applications in places where all measurements are made indoors, or where the computer part is not required to be outdoors. As the standard working temperature range of most computers is only +5 to +35 degrees Centigrade, even a computer in an environmentally protected case is not ideally suited to outdoor use in many countries, especially as many computers have considerable problems keeping their internal temperatures low enough (almost every processor is now has a fan fitted directly on it), and hard disks have difficulty in spinning up to speed at around freezing point. Many of the cases used for protection are also very efficient thermally, which only serves to further raise the internal temperature of the equipment. It therefore suggests that, at present, leaving any form of PC outdoors for any reasonable period of time is not the best idea.

Although great strides have been made in power consumption of PCs, even the best laptop's internal battery life is measured in hours, not days, so having a PC as part of any environmental noise monitoring system would not appear to be really worthy of consideration in late 1998. But there is no denying that many users appreciate the flexibility of approach that gathering data directly on to a PC offers. How is this best accommodated?

The author believes that two approaches, each with possible variations, will emerge to replace the existing sound level meter in a case package. They have one common feature. The acoustic instrument manufacturers will design and manufacture a high quality front end that is guaranteed to provide data that fully complies with all the Standards for acoustic instrumentation already existing or in preparation. In some case this could be an adaptation of existing instrumentation. The choices will arise depending on user requirements.

The first approach will probably be the use of electronic Personal Organisers or Personal Digital Assistants (PDAs) instead of PCs. There are already on the market a number of products in this field that have the ability for the user to write their own programmes. The recent announcement of a major take-up of the EPOC operating system, developed by Psion in the UK, by many of the world's leading PDA manufacturers means that the generation of PDAs currently being designed will have more extensive programming capabilities than ever before. But these devices have battery lives measured in days of continuous operation already, and they have modem and e-mail capabilities as standard.

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Fitting one of these devices in a pack with the front end electronics, in such a way that the PDA is removable if required, will produce a package little bigger than the standard sound level meter, but with enough storage and processing power to equal the current product offerings, and with the ability to communicate to other computers if required. This is still essentially a serviced system, as it will require fairly frequent attendance by someone to collect the measured data, replace batteries etc. However, the flexibility for data processing, provided the raw data is of sufficient integrity to support this processing, is almost unlimited.

The second approach is to take the same front end system, but provide dial-up facilities and programmes to suit the type of data collection that is required. This will probably not take the form of a line connection, but will consist either of a radio modem or a digital (GSM) mobile phone.

Nearly all the major suppliers of mobile telephones have modems available that can be connected directly to the handset, and therefore the option to, say, dial up once per hour or once per day for the results, taking just a few seconds or minutes to transfer the information, is very straightforward. Continuous data transmission of the reduced raw data would be quite cost effective on the radio links, but power requirements will limit the duration unless connected to a public power supply. Of course, where a telephone line is available, it would be simple to use either a dial up or continuous connection as required.

Conclusions

The increasingly diverse data requirements for environmental noise monitoring are most likely to be met by bespoke software on computers rather than inside dedicated instruments. However, gathering raw data for processing is not a very efficient way to use the computer. Adapting existing microphone and sound level meter signal processing stages to reduce the amount of data needing to be sent to a computer requires specialist knowledge, but has been available for a long time from most of the major manufacturers inside sound level meter designs. By adapting the data outputs, an environmentally protected measurement system can be produced that, when coupled to appropriate data processing systems, will deliver to almost any location the information required. Thus the PC is likely to become the final repository of the data rather than the total replacement for the measuring instrumentation. Comprehensive measuring instruments like the CEL-593 are suitable for this approach, and a wide-dynamic range version, with real-time digital outputs, will be available shortly, together with a suite of modems, interconnects and PC programmes, that will deliver many of the attributes described in this article. It will remain to be seen whether this approach becomes the 'norm' for environmental noise monitoring in the future.

Richard Tyler FIOA is Manager, Advanced Engineering at CEL Instruments Ltd, 35 - 37 Bury Mead Road, Hitchin, Herts SG5 1RT. ❖

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STANDARDS FOR A QUIETER WORLD: SOME ACOUSTICAL REFLECTIONS FROM THE UK NATIONAL PHYSICAL LABORATORY

Bernard F Berry FIOA

Introduction

In 1931, in an early example of a general review article on noise and its measurement, Dr G W C Kaye, who was at that time in charge of the Physics Department at the National Physical Laboratory (NPL), wrote in the journal *Nature*: *It was Lord Kelvin who said that once we find out how to measure a thing we begin to learn something about it. As regards noise, however, it is evident that the question of its measurement is one of some complexity, involving not only physics, but also physiology and psychology. Nevertheless, it is clearly desirable that there should be a consensus of opinion on the choice of a system of physical quantities. They should be preferably of an absolute character, so as to assist, inter-alia: (a) in translating vague aural judgments and comparisons into facts and figures; (b) in elucidating the causes and characteristics of noises; (c) in comparing the results of different investigators; and (d) in setting up such arbitrary standards of noise as may be desired in the light of social, technical or legal requirements.* [1]

Thus, from the early days of serious scientific interest in noise, there was recognition of the vital importance to the process of noise control of standardization – of measuring instruments, measurement methods, of noise criteria. For more than 70 years, NPL has contributed to national and international standardization in the field of acoustics, and, through this process, NPL has, in my view, contributed to a quieter world. But, in an ironic way, the work has itself gone on quietly in the background. It therefore seemed appropriate, in view of the theme of INTER-NOISE 97, to review, from my personal perspective, the contribution which NPL has made. The review is in two parts. The first covers the time from the origins of work on noise in the 1920s to the beginning of the 1970s, when I started work at NPL, and the second the period since the 1970s. The main emphasis will be on specification standards, but reference will be made to key aspects of the work on metrological standards, which of course, through the realization of the basic standard of sound pressure, underpins all acoustical measurements. The paper will not deal with the processes of standards development, comprehensively described by Robinson [2].

Definitely Before My Time – From the Origins of NPL to the Swinging 1960s

Even before it officially existed, the embryonic National Physical Laboratory had strong links with the most famous acoustician of his time, Lord Rayleigh. A com-

mittee formed in 1895 to consider the establishment of a national laboratory, reported to the 1896 meeting of the British Association for the Advancement of Science in Liverpool. The third Baron Rayleigh, John W Strutt, was one of the 14 members of this committee. The committee succeeded in convincing the Government of the day to set up an official 'committee of enquiry' under the chairmanship of Lord Rayleigh. The committee's recommendations were accepted in October 1898, and financial aid was voted by Parliament – £4000 for 5 years as a grant in aid of the expenses of the Laboratory, and £12000 toward the erection of suitable buildings. An Executive Committee was formed in May 1899 with Lord Rayleigh as Chairman. The first Director, Dr (later Sir) Richard Glazebrook, was appointed from 1 January 1900. Lord Rayleigh continued as Chairman of the Executive Committee until his death in 1919, and is known to have taken an active interest in the work of the Laboratory, in particular as President of the Advisory Committee for Aeronautics, which was formed in 1909 [3, 4].

From its inception to the present day, the Laboratory has published an Annual Report. In the early days, these were handsome leather bound volumes, but have now become glossy paperbacks. Perusal of these early volumes provides many fascinating insights into various aspects of the functioning of the Laboratory. Thus it is interesting to note in the report for 1908 the use of the term Computer. Closer inspection reveals this to refer to the staff grade of a particular employee, a Mr W H Brookes, whose job was presumably to undertake mathematical computations for the whole of the Physics Department.

Early Reflections – the 1920s

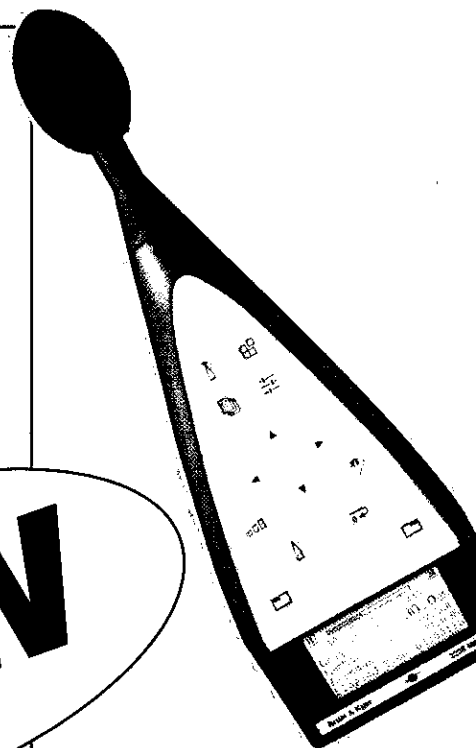
The first reference to work on acoustics comes in the Annual Report for 1921 when a Sound Division was set up in the Physics Department. In these early days the emphasis appears to have been on architectural acoustics, for example the application of sound-pulse photography to the study of waves in a model auditorium. In 1925 these techniques were used to investigate the possible use of hangars to screen 'certain areas from the sound waves set up by the engines of stationary aeroplanes'. It is etymologically interesting to note that the word *noise* was not used. International contacts were strong even then, with reference in the 1925 Annual Report to work on the acoustic properties of the Town Hall in Melbourne, Australia.

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Fig. 1. NPL 'audiometer' ca 1929.

Rayleigh disk method, refractometric measurements of density variations in air and the vibrating diaphragm method. This work continued through the decade, with efforts mainly concentrated on the Rayleigh disk method. In view of more recent developments to be outlined in due course, it is interesting to note in the 1929 report the summary of work on low-frequency calibration of microphones using an electrically driven pistonphone. A small mirror, rotated by the motion of the pistonphone, gave an indication of piston amplitude. Amplitude measurements, not necessarily reliable, were reported up to 1 kHz.

The first specific reference to 'the study of noise' occurs in the report for 1928, but only by way of an example of the kind of scientific work which was suffering because of the lack of a dedicated laboratory building. For details of early work on noise, one has to wait until 1929 when mention is made of the first portable instrument for measuring the 'mean sound pressure of sound in noises'. Mention is also made of 'aural measurements' which used the *Barkhausen principle*. This involved using a telephone earpiece in which the level of a reference noise could be adjusted in 14 steps to match that of the noise under investigation (see Figure 1). The scale of loudness was said to have been calibrated in absolute units by connecting the telephone earpiece, via an artificial ear canal, to a calibrated microphone. The first practical measurements involved the noise of aircraft and were undertaken in close collaboration with the Royal Aircraft Establishment (now Defence Evaluation and Research Agency) at Farnborough. 1929 also saw the formation of the first government committee on noise,

a sub-committee of the Aeronautical Research Committee.

The 1930s

A year after the very first mention of noise in the Annual Report for 1930, an extensive series of measurements was made on both interior and exterior noise of a range of aircraft types [5].

After several years of planning and preparation the new building for work on acoustics finally opened in 1933. With considerable extension and modification the building remains to this day as the *Rayleigh Building*. The new building included a larger lagged chamber than had been previously available and the report for 1934 notes the use of this chamber to extend the low frequency limit for the 'field calibration' of condenser microphones.

The first example is also recorded of an inter-comparison of the absolute calibration of microphones between NPL and the Post Office Engineering Laboratory, with an average difference of 0.5 dB, over the frequency range 80 Hz to 6 kHz, being noted.

Work on a portable noise measuring instrument, first referred to in 1929, resulted in 1934 in a forerunner of our modern sound level meters, shown in Figure 2. One application was in an interesting series of tests conducted on the noisiness and 'stridency' or harshness, of motor horns (see Figure 3). This is the first time that the issue of noise with strong tonal components appears to have been considered in the UK. The 1934 Annual Report refers to this instrument as an 'acoustimeter' while the term 'audiometer' is used for the instrument involving subjective comparisons of noises. The acoustimeter was arranged to give 'equal meter indications for equally loud notes, whatever the pitch'. The equal loudness contours of Fletcher and Munson [6], formed the basis of this equalization. The indicator was designed to give a full indication of loudness in about $\frac{1}{3}$ of a second after the application of a steady noise 'so that it roughly simulates the ear in this respect'. The meter was described by Davis,

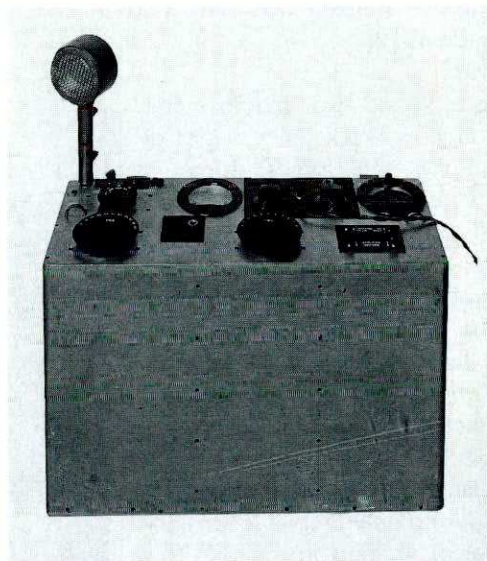


Fig. 2. NPL objective noise meter, 1938.

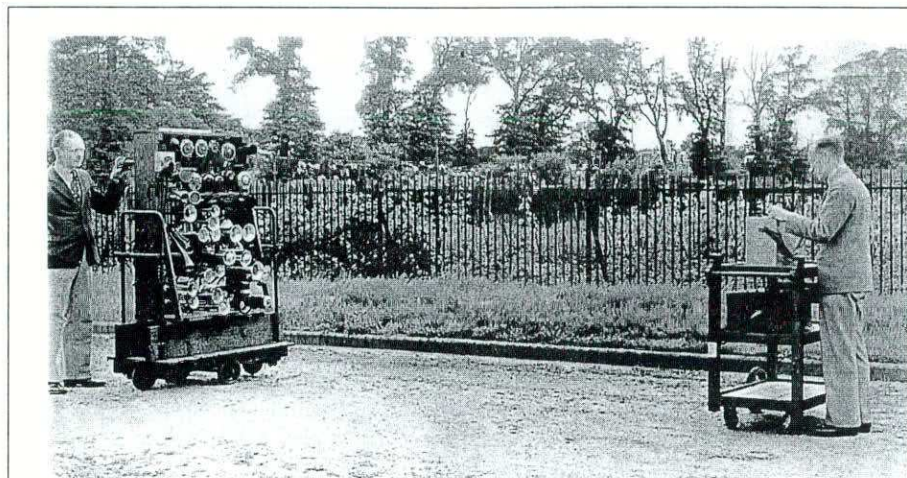


Fig. 3. Noise of motor horns, 1929.

who also gave an interesting and valuable review of related work of others in the field at the time [7].

One of the key applications of the acoustimeter was in the study of motor vehicle noise in connection with the deliberations of another early example of a Government committee. This was the Ministry of Transport's arcanelly named 'Departmental Committee on Noise in the Operation of Mechanically Propelled Vehicles'. Figure 4 shows some early measurements on the NPL site of the pass-by noise of a car.

The 1934 report also contains the first direct reference to the British Standards Institution (BSI) in the context of a recently proposed standard procedure for measuring the loudness of sounds. In essence, this standardized the 'equivalent loudness' as the intensity of an equally loud pure tone of 1000 Hz, with the zero loudness being 0.0002 dynes per cm².

The importance of NPL work on noise is indicated by the publication in 1937 of one of the earliest reference texts on the subject, authored by A H Davis [8].

In 1938, the acoustimeter, now known as the objective noise meter, having been the subject of further improvements in performance particularly in dealing with impulsive noises, was described in considerable detail by Davis [9].

The 1940s

The Second World War did not mean the cessation of work on acoustics at NPL. Among the topics listed in reports were the problems of reproducing the noise of tanks on sound films, sound insulation of aircraft cabins and reduction of noise from aero-engine test cells. Advice was sought in 1944 in the preparation of plans for the new House of Commons to replace that destroyed in 1941.

Soon after the war, work on noise measurement was greatly assisted by the arrival of a new mobile laboratory – the first of its kind in the UK. This was said to have travelled more than 4000 miles in its first six months of

operation, being employed in measurements of the noise from jet-engine test cells and investigations of noise reductions in new post-war factories.

The 1946 report records the hope that work would resume on further improvements to the objective noise meter. However this did not materialise and the NPL meter was eventually overtaken by developments elsewhere on sound level meters. Sadly, the NPL Museum contains no remnants of this key work.

There were no major developments in work on basic acoustical

standards, although the frequency ranges for microphone calibrations were extended by the introduction of the first anechoic wedge room-linings at NPL and the construction of a special ducted enclosure.

The 1950s

The 1950s began with the start of 4 years of a major effort by Robinson and others on the redetermination of the equal loudness contours, extending the work of Fletcher and Munson in the USA and of Churcher and King in the UK [10]. The contours were first published fully in 1956 [11] and the Annual Report for 1957 notes provisional agreement by the recently formed Technical Committee 43 of the International Organization for Standardization (ISO) – itself only formed in 1953 – on the equal loudness contours and on the relation between the scales of loudness (sones) and loudness level (phons). The International Recommendation was published in 1961 [12] and the NPL work also strongly influenced the form of the weighting curves in the first ever international standards on sound level meters [13].

In response to growing demands for a standardized test of motor vehicle pass-by noise, initial subjective experiments, using real vehicles on a main road in the south of England, were conducted by Robinson and others in 1959 [14]. These tests showed the superiority of



Fig. 4. Motor vehicle noise, 1934.

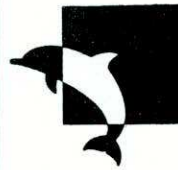
the A-weighting. Soon after, more extensive tests, with controlled pass-bys and a jury of listeners, established the necessary information on the relationship between subjective ratings and the meter readings [15]. The results of this NPL work were incorporated directly into ISO Recommendation R 362 [16].

The mid-1950s also saw the beginning of studies on the measurement of noise from aircraft in flight which were to have a strong influence on the development of standards for the measurement and certification of aircraft noise in the following years. In 1954, Fleming supervised a large series of measurements on 4 fixed-wing aircraft and one helicopter, using fixed positions relative to take-off and landing. The work is of particular interest as these were some of the earliest tests to make use of weighting curves for sound level which had been standardized by ANSI [17].

The 1960s

In 1962, with input from NPL, ISO issued a draft procedure for evaluating the noise around an airport from measurements made only under the flight path. To test out this procedure measurements were made, in collaboration with Rolls Royce Ltd at their test site at Hucknall, on a Meteor aircraft. These involved a grid of 39 points over an area of 10 square miles. The draft procedure was shown to give good agreement between predicted and measured levels. In 1965, further measurements were made which involved the combined resources of seven laboratories and a test area of 24 square miles [18]. ISO Recommendation R 507 was first published in 1966 [19].

As well as these examples of work on purely objective measurements, NPL retained an interest in subjective response to aircraft noise. Some early examples of controlled subjective tests occurred during the 1959 Farnborough Air Show. These involved a jury of listeners, 1600 in total, in groups of about 100, rating recorded aircraft noises and synthetic noises using the paired-comparison technique. The objective was to see whether the relative ratings of the noises would be in accordance with the recently developed 'noise assessment scales' of Stevens [20] and BBN [21], the latter being the early form of the perceived noise level scale. Perceived noise level was found to perform slightly better than Stevens phons [22]. In 1960, a similar experiment using 570 subjects was conducted at NPL but this time the sounds were recordings of helicopters. The conclusion from this experiment was that Zwicker phons were superior to PNL or Stevens phons. The A-weighted sound level was noted to be as good as Stevens phons in ranking either loudness or 'disturbance' [23]. In 1961, the first experiments using actual aircraft flyovers took place at that year's Farnborough Air Show [24]. Over 3 days, 60 subjects made judgments on rating scales of noisiness and intrusiveness (see Figure 5). Objective measurements were made in dB(A) and PN dB. Among the interesting results it was found that subjects judged sounds heard indoors more severely than sounds of the same level heard outdoors. The difference was about 18 dB(A) (see Figure 6). This difference was much the same as the noise reduction



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Fig. 5. Outdoor judgements of aircraft noise. Farnborough Air Show, 1961.

provided by the building. It was suggested that this 'projection effect' was due to subjects making a subconscious allowance for the building attenuation. The result was confirmed in tests carried out at the 1964 Air show using 148 subjects [25]. It is interesting to note that the same effect has subsequently been found by a number of researchers [26].

In 1963, Robinson compared the results of the aircraft noise tests with the earlier judgment tests on motor vehicles [27] (see Figure 7). This result represents one of the earliest inputs to the debate which has ensued ever since concerning the need for 'source corrections' to harmonized noise scales.

The importance of the role of NPL was recognized in 1961 by the choice of the Laboratory to host the very first major international conference on noise ever held in the UK [28]. Three hundred delegates from around the world spent 3 days attending presentations and a number of demonstrations of noise analysis equipment and exhibits illustrating the principles of noise control. The demonstrations included one of the earliest known applications, certainly in the UK, of a digital computer – the NPL ACE machine – to the calculation of PN dB and loudness by the Zwicker and Stevens methods. The details of the calculation procedure for the Zwicker method, which used 30 seconds of computer time per noise sample, were published later [29].

The 1961 conference coincided with the start of deliberations of the Government committee on the Problem of Noise, known as the Wilson committee after its Chairman, Sir Alan Wilson, FRS. NPL staff made a substantial input to the committee and several of the previously cited scientific papers were reprinted as appendices to the Report [30]. The Report formed the basis for many of the developments that were to follow in UK legislation on noise and was regarded for many years as a vital reference text by practitioners of all kinds.

Also in this very productive period of the mid-1960s, NPL staff were involved in pioneering studies concerning sonic booms at a time when concern was growing that the development of supersonic passenger transport would lead to exposure of the general population to this

unusual form of aircraft noise. In addition to studies of subjective effects [31], Robinson developed a variant of the Stevens loudness calculation procedure [32]. NPL's work on the techniques required for the accurate physical measurement of sonic booms had a profound influence on the development of the relevant ISO standard [33], but standardization of methods for evaluation of subjective effects did not proceed. With the disappearance of the threat of widespread exposure, interest in the topic in the UK dwindled and, in fact, ISO formally withdrew ISO 2249 in 1995.

The 1960s was also a productive time in the field of occupational noise. Although the first schemes for the research are said to have appeared in the late 1950s, the origins of one of the most extensive and influential studies

ever undertaken of the relationship between occupational noise exposure and hearing levels of industrial workers can be seen in the NPL Annual Report for 1962. The project was jointly run by NPL and the UK Medical Research Council. Audiometric field work began in July 1963 with the aid of a new mobile audiometric laboratory [34] and continued for more than 5 years. A new mobile noise measurement laboratory was used to obtain details of exposure in a range of factories across the UK. The study involved both retrospective analysis on 759 exposed subjects and a prospective study with serial audiometry on 493 subjects. Even before final completion of the work,

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an interim report, which described how noise level and duration could be combined into a single measure termed *noise immission*, led to radical revisions of draft recommendations on hearing conservation being considered by ISO [35, 36]. The study is described in full in the book by Burns and Robinson [37].

After preliminary work at the end of the previous decade, the gradual move from the reliance on the Rayleigh disc method for absolute calibration towards the use of reciprocity, gathered momentum. At the Baden-Baden meeting of Technical Committee 29 of the International Electrotechnical Commission (IEC) in 1962, Working Group 13 Absolute Calibration of Microphones, was established to formulate an international standard. NPL was involved, along with the national standards laboratories of six countries, in an international inter-comparison [38]. A draft standard for calibration of one-inch microphones by the reciprocity technique was developed, validated at NPL by Delany [39] and eventually published [40]. Work began on extension to one-half inch microphones and also on improvements to diffraction corrections required to derive free-field sensitivity.

Late Reflections, from the 1970s Onward

I started work at NPL on 2 November 1970 and initially worked on the development of recommended maximum background noise levels for audiometry [41]. Soon after that I switched my primary research interests to environmental noise. For this part of my review, I shall consider

primarily work in which I have personally been involved and describe developments chronologically within each subject area. Because of limitations of space and time, this review cannot be all embracing, but the interested reader is referred to the index of NPL publications which has been produced regularly since 1960 and which can be obtained from the author.

Harmonization of Noise Ratings

My arrival at NPL coincided with the rapid growth of interest in the question of unification or harmonization of the wide range of noise indices then in use. Robinson had just published an early paper on the topic which introduced the concept of *Noise Pollution Level* [42]. I reviewed the different noise indices then used in the UK for traffic, aircraft and industrial noise, and showed how, using L_{Aeq} as an intermediate measure, one could derive 'equivalent values' of the separate indices [43]. Over the next few years, NPL and other organizations and individuals contributed to the deliberations of the UK Noise Advisory Council, which had become concerned at the multiplicity of noise immission measures in use in the UK for planning and regulatory purposes [44]. The need for a reference work on general concepts, methods of measurement and prediction was met by the *L_{Aeq} guide* [45], which was compiled and edited by NPL staff, and which had a significant impact on developments within the UK in subsequent years. A few years later the Department of the Environment (DoE) commissioned NPL to undertake a wide ranging review of the use of L_{Aeq} in the UK [46]. This review considered current applications, recent policy



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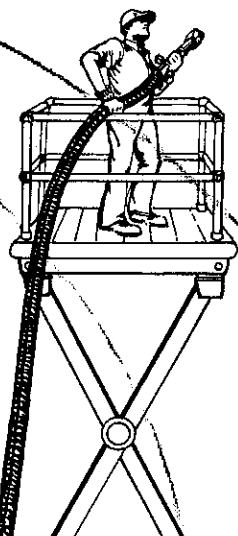
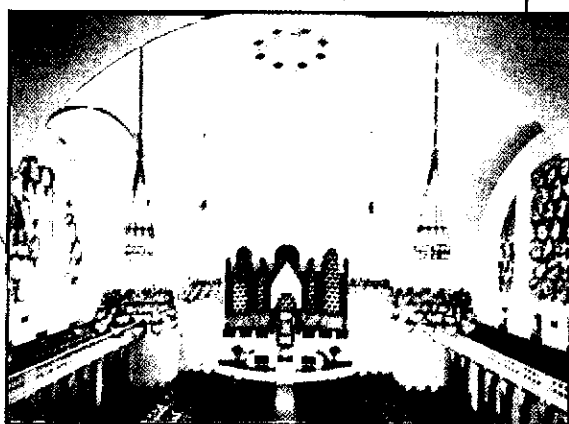


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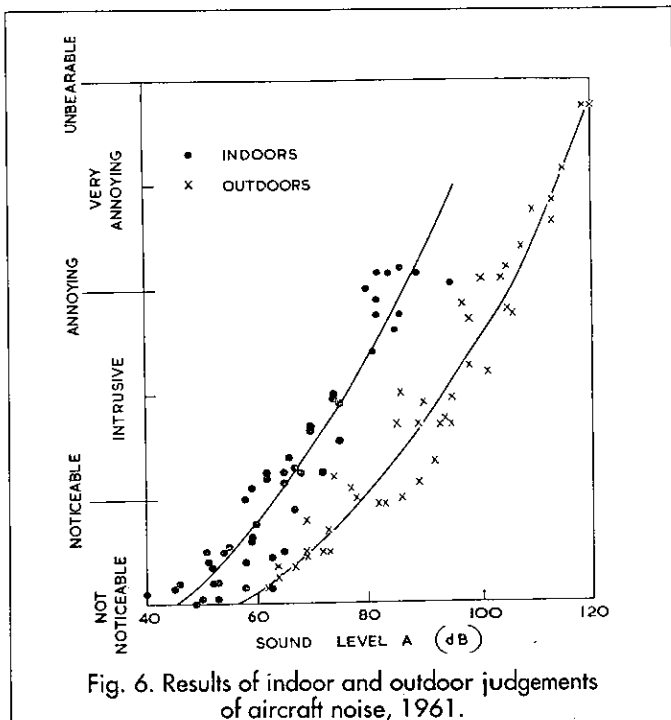


Fig. 6. Results of indoor and outdoor judgements of aircraft noise, 1961.

assessments, international developments, subjective reaction to different noise sources, the comparison of L_{Aeq} and other measures as predictors of subjective reaction and recent developments in measurements and prediction practices. The work on subjective reaction to different sources was published for INTER-NOISE 83 [47]. The review also highlighted the need for further research on industrial and impulsive noise and this resulted in the studies described in the next section. The general move in the UK towards the use of L_{Aeq} -based indices continued with the change from the use of *Noise and Number Index* for civil aircraft noise [48] and the formulation of noise compensation measures for military aircraft noise in terms of L_{Aeq} [49]. At the international level, a key event was the publication of ISO 1996 in 1982 [50].

The slow process towards eventual harmonization still continues in the late 1990s with the long awaited revision of UK planning guidance [51] which uses L_{Aeq} for all noise sources, with the publication of a Green Paper from the European Commission on Future Noise Policy [52] and with the organization by the Commission, together with the Danish Environmental Protection Agency, of a related special conference later this year, a report of which appears in this issue. The Government of the Netherlands, through its Health Council, formed early in 1997 a new multi-national Committee of experts on which NPL was represented, to consider and report on a 'Uniform noise exposure metric' [53].

Subjective and Objective Assessment of Industrial Noise, Including Tonal and Impulsive Components

At INTER-NOISE 85, the first results were published of a series of experiments on the dependence of annoyance on basic physical parameters of impulsive noise such as decay time and repetition rate [54]. In collaboration with the late Professor Zwicker, the results were re-analysed using the newly developed digital loudness meter [55]. The detailed report on this work appeared in 1987 [56].

The best fit between objective and subjective data was obtained using a descriptor developed in earlier NPL work on helicopter noise [57]. The report also proposed the use of descriptors of impulsiveness based on very short-term L_{Aeq} time series. NPL then became involved in collaborative studies funded by the EC. These involved subjective tests in laboratories in the UK, Italy and the Netherlands and objective analyses at NPL and the University of Dusseldorf. This led to the development of the 'Increment' descriptor [58] (see Figure 8).

With the aim of refining current standard methods for rating industrial noise, work began in 1990 on a 3-year project funded by the UK DoE. A review of related practices in 20 countries was undertaken [59]. Also, an extensive programme of subjective listening tests was conducted on the judged annoyance of specific types of industrial noise, including combinations of tonal and impulsive noise [60]. Follow-up work has concentrated on the issue of tonality [61]. The work has led to the development of a fundamentally new approach to noise assessment based on the acoustic features present in the noise environment [62].

At the level of national standards, NPL has led the Committee of the BSI revising the 1967 edition of British Standard 4142 to make use of L_{Aeq} , and producing the 1990 edition. Further revisions have recently resulted in a 1997 edition [63]. Contributions have also been made to the work of ISO Working Group 45 in revising the impulse corrections in ISO 1996 Part 2. The Working Group is now continuing, under its Convenor Dr Paul Schomer, with the bigger task of a complete revision of ISO 1996. The first meeting was held at INTER-NOISE 96.

Aircraft Noise

When the original schemes for noise certification of aircraft were introduced in 1967, the requirement was for measurements with a microphone height of 1.2 m above

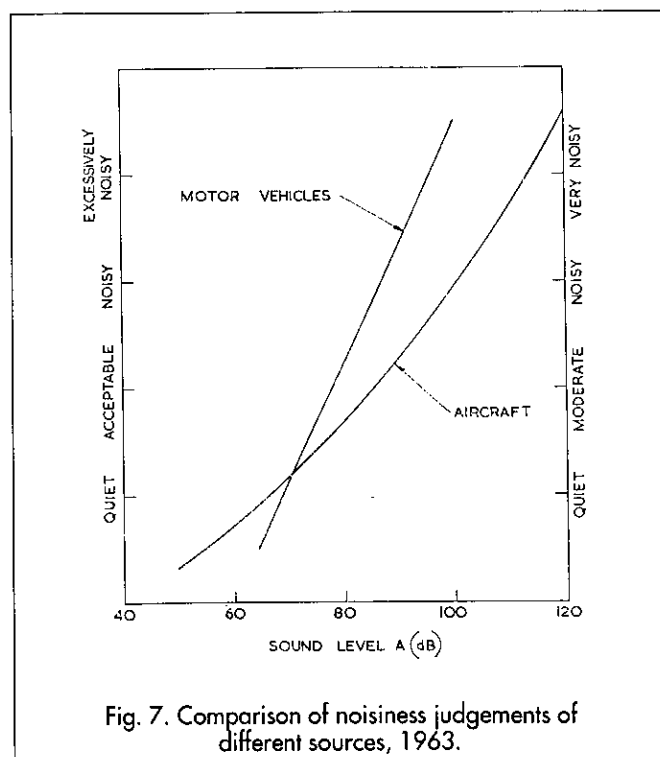


Fig. 7. Comparison of noisiness judgements of different sources, 1963.

ground surface level. Such measurements are, of course, subject to the effects of cancellation and augmentation due to interference between the incident and ground-reflected waves, resulting in distortion of the true free-field spectrum. An extensive series of experimental and theoretical investigations by NPL showed the benefit of using a ground-plane microphone arrangement. The arrangement has now been included in the standards for the certification of light propeller aircraft [64, 65].

NPL hosted the inaugural meeting of ISO TC43 Working Group 43 in May 1994 and has actively contributed to its work on the revision of ISO 3891 [66].

In late 1979 NPL was asked by the UK Ministry of Defence to develop a mathematical model for the prediction of noise around military airfields. The resulting model – AIRNOISE – was completed in 1981, and has since been used extensively in the determination of housing zones eligible for compensation [67]. In 1990 attention turned to the problems of low-altitude flying. A controlled field trial was conducted on 6 types of military jet aircraft flown straight and level at heights between 100 and 250 feet, at various speeds and engine power settings. The results of the work had a direct influence on standards of a different kind, namely the rules governing the allowable altitude and speeds in the UK low-flying system [68]. A prediction model – FLYBY – was developed, and found to give accurate estimates of the time-history of the noise of low-flying aircraft [69]. An important parameter governing the subjective response to such noise is the rate of change of noise level at the beginning of the event, or *onset-rate*. The problem of the lack of a standard for the measurement of the onset-rate was addressed in 1995 [70].

Developments in Acoustical Standards

In 1977 details were published of a new laser pistonphone, developed at NPL by Rennie, in order to extend the lower frequency limit for absolute calibration [71]. The device was further refined by Richard Barham in 1993 [72], thus completing the process started in 1929. During the 1980s, most effort was applied to the extension of the standard for reciprocity calibration to one-half microphones, and a major comparison of national standards of sound pressure was undertaken [73]. More recently, the IEC has reviewed IEC 327 and brought it up to date in a new series of Standards, IEC

1094 – Measurement microphones. These include a primary method for free-field calibrations [74].

With the growing interest in techniques of sound intensity measurement, the need arose for a standard specifying minimum requirements for instruments. NPL contributed to the development of IEC 1043 and developed a service for periodic verification [75]. NPL has also taken the leading role in development of a new British Standard for the verification of sound level meters [76] and in current work of producing a new international standard for sound level meters [77].

Summing the Reflections – Thoughts on the Future

In looking back over the years, one is struck by the similarities between the early years and now in the basic aspects of the noise problems under consideration, and by the lack of real progress in key areas – despite the passage of time and much research. Thus, in the description of the 1938 acoustimeter or objective noise meter, one can see early evidence of the magnitude of impulse 'corrections', which have only recently – nearly 50 years later – been the subject of amendments to ISO 1996. But one is also struck, naturally, by the differences in the methods used in the research, arising from the developments in technology, and the ease with which one can now accomplish complex tasks. One example would be the generation of signals for subjective testing, where space-consuming and power-hungry hardware has been replaced by the PC and software, in many cases readily available via the Internet. But of course it is the very ease with which one can generate such signals and perform complex analysis tasks which has itself led to the proliferation of possible ways of assessing noise, and so ensured that the debate over optimum metrics, indices, descriptors, etc, continues. Another example would be the availability of lasers and optical techniques now used in microphone calibration.

As we look to the future, it is clear that technological developments in the late 1990s will not only change the nature of the noise sources under investigation, but also continue to influence the techniques applied in research on noise and its effects, and the work on the realization of primary standards. These developments will also change the very infrastructure by which the process of standardization happens. A number of standards bodies, including the Audio Engineering Society, are already using FTP (File Transfer Protocol) servers to give committee members online access to documents, and email for discussion groups. A European consortium on Internet Working for Standardization, which includes BSI, is urgently evaluating a number of possible future strategies. There are obvious advantages in speed of working and a broader base for comments, etc, but the problems of

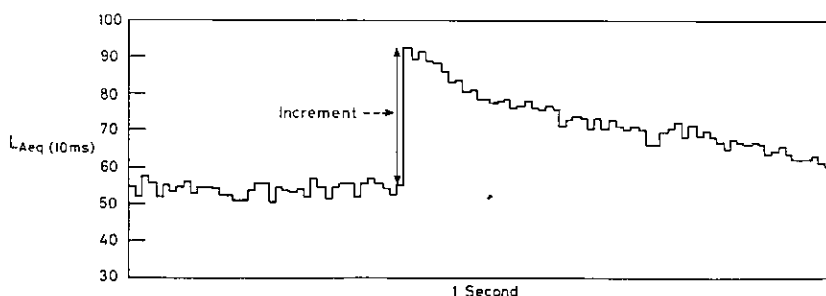


Fig. 8. 'Increment' descriptor of impulsive noise, based on short-term L_{Aeq} .

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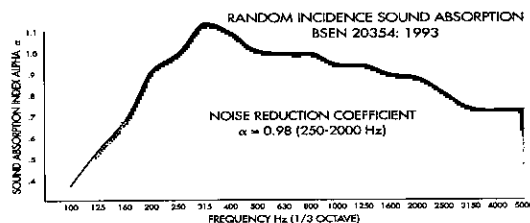


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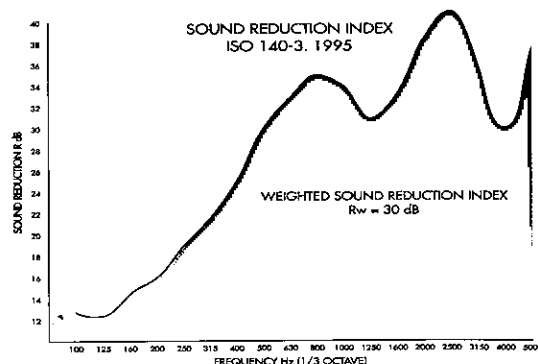
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achieving consensus are likely to increase.

In this article I have attempted to describe some of the key threads running through NPL research on noise since its origins in the 1920s and to show how the research has influenced standards for a wide range of acoustical applications. I have also given examples of the ways that NPL research has been used by Government departments and committees in the framing of key items of legislation, guidance etc. I believe that the work of NPL, and the contributions of other organisations and individuals involved in research and in the process of standardization, have provided essential tools to help all those engaged in the essential task of international noise control – and so have helped to make a quieter world.

Acknowledgments

I would firstly like to acknowledge the invaluable contribution of the staff of NPL Main Library, and in particular Mrs Sue Osborne, in the preparation of this paper.

I would like to thank Professor Douglas Robinson who supervised the start of my research career at NPL in 1970, and with whom, in his present capacity of Visiting Professor at the Institute of Sound and Vibration Research, I still enjoy stimulating and creative discussions.

My thanks to all of the colleagues at NPL with whom I have had, and still have, the pleasure of working, and who have been part of NPL's contribution to the making of a quieter world.

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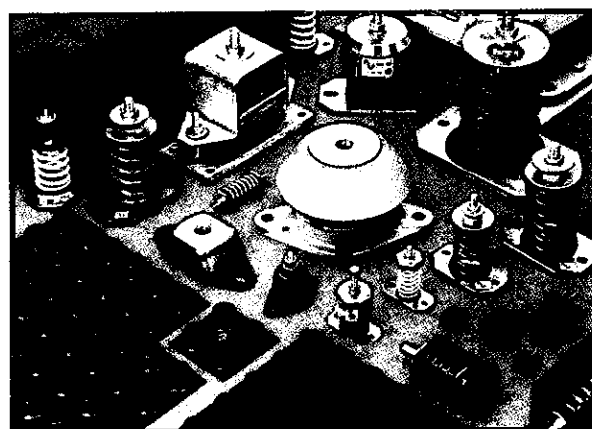
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This article is based on material which was first presented as a Distinguished Lecture at the 1997 INTER-NOISE Congress in Budapest, Hungary, and later appeared in the June 1998 issue of Noise/News International. © Crown copyright 1998.

Bernard F Berry FIOA is Immediate Past President of the Institute and is Head of Audiometric and Noise Standards, National Physical Laboratory. ♦

ENGINEERING COUNCIL QUARTERLY REPORT: September 1998

Malcolm Shirley CEng

On this, my first occasion of contributing to your Institution journal since becoming Director General of the Engineering Council, I sense that the profession is facing a period of considerable challenge and great opportunity. The biggest challenges are to raise the public profile of engineers and engineering, together with ensuring that more young people of the highest calibre choose engineering as a rewarding career. Arguably the opportunity to achieve this is greater than ever before.

Both of these objectives are inter-linked, of course, and it is clear that no single organisation on its own can successfully bring them about. It is only by combining resources that we in the profession – and the wider engineering community – can hope to succeed. The best way to achieve this is with unity of purpose and clear dialogue, particularly between the Engineering Council and the professional Institutions which it serves.

After nearly three years in its present form, I believe that I have taken over an effective Engineering Council that is able to make an extremely positive contribution. I feel privileged to be the beneficiary of what was achieved by my predecessor, Mike Heath, who did a great deal to establish the new Council and its staff, culminating in recognition as an Investor in People this summer. He also did much to develop the Council's partnership and working relationships with the professional Institutions and other organisations, relationships which we now need to consolidate and develop. We are currently also finalising the Council's new strategy for the future, as well as refining our activities and processes to maximise the focus and cost-effectiveness of the services we provide to registrants.

One of the main achievements of the Council has been to ensure that the voice of the profession is heard and its influence developed at a national level, in government and at Westminster. It was a major achievement for the Council, as the lead body for the whole of the profession, to agree with Government the Memorandum of Understanding that has enabled engineering to make an increasingly valuable contribution to the national decision-making process. With the specialist lead of individual engineering Institutions, the Council is now able to put the profession's responses to a wide variety of pertinent consultation documents that form a key part of the legislative programme. This is just one of the goals of the Council as, with its partner Institutions, it addresses many of the long-standing concerns of engineers, including better recognition of their status and their contribution to everyday life.

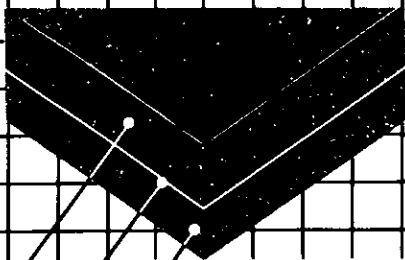
If the British economy, both industry and commerce, is not to face damaging skills shortages, the profession must ensure that not only are the best youngsters attracted to engineering, but that their education and training are sec-

ond to none in order to prepare them for what undoubtedly will be a world of increasing technological emphasis and challenge. This is why raising the profile of engineering and ensuring the profession is widely recognised as an exciting and well-paid career are so essential.

There is a full agenda of proposed and committed programmes to demonstrate engineering's contribution to national wealth creation and the well-being of the public. The most far-reaching of these is the proposed National Marketing Campaign, which is being developed by a major communications agency for a joint venture partnership comprising the Engineering Council, the Engineering Employers' Federation and the Engineering and Marine Training Authority. This campaign will use the power of television commercials and other national advertising to target young people and those who influence them. It is planned to be long-term – but its success will depend upon the strong support of industry.

Driving these initiatives is the realisation that, for UK engineering to remain world class, the brightest and most talented of children and students must be fired with the

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challenge and excitement of what an engineering career can offer. Importantly, these major new initiatives are receiving the backing, not just of the profession, but of the broader engineering community. This is as it should be, because employers, consumers and society in general will be the ultimate beneficiaries.

The Quinco campaign, which is committed to co-ordinating the promotion of engineering for the next five years, has in the short time since its formal launch this summer attracted support from some of the major industrial companies – as well as receiving endorsement from the Government. Part of what Quinco is aiming to achieve, through a range of projects across the UK, is to change many of the incorrect perceptions of engineering that have become culturally ingrained. That too is the target of the National Marketing Campaign, which is included in the Quinco project portfolio.

The Engineering Council is additionally exploring a range of proposals to increase awareness of the role and contribution of registered engineers, and these are being discussed with the Institutions. Principal among these are voluntary schemes of licensing for individual engineers in prescribed areas of work, particularly in activities with a health and safety or risk element. We have also suggested that Chartered and Incorporated Engineers have a prefix 'Engineer' title, as medical practitioners use 'Doctor'. These concepts are being developed in conjunction with the professional Institutions.

Evidence that the changing skills' needs of industry and business are being addressed is found in many areas of the profession. One example is the Standards

and Routes to Registration (SARTOR) policy document that recognises that many of today's engineers require a broader education and should be trained in applying the latest technologies to find creative business solutions.

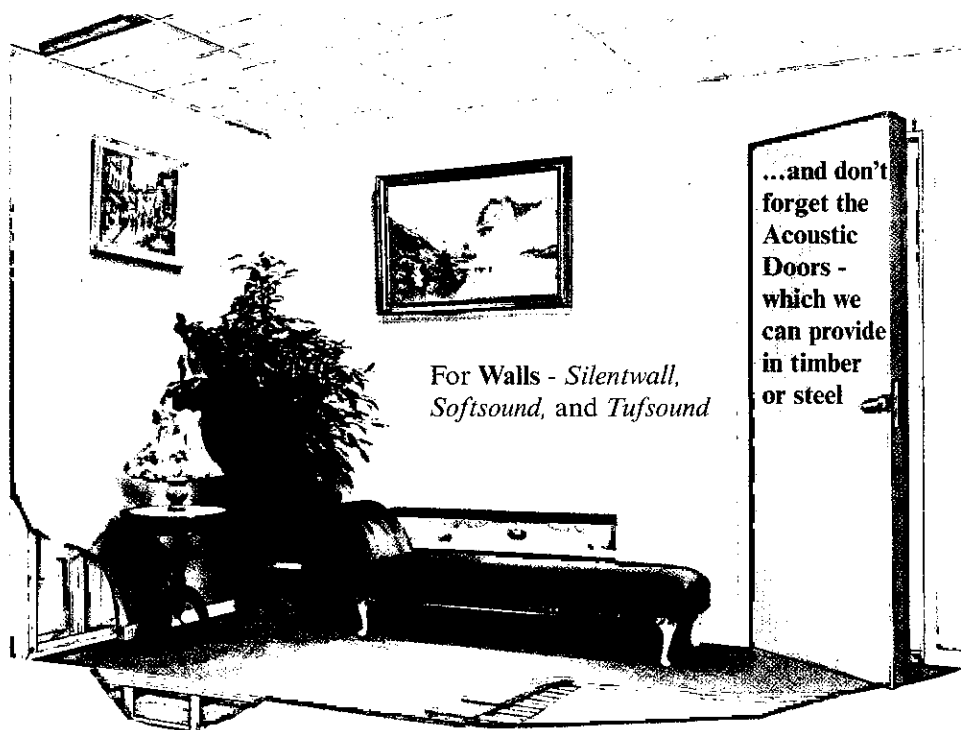
There will continue to be a place for engineers more at home with applying theoretical knowledge, but the priority is for the more practical breed of professional, in the form of the Incorporated Engineer. Which returns us to meeting the needs of industry and business. With a stronger emphasis in the formation process on vocational subjects in higher education, we can ensure that there are increasing opportunities for young people with aptitude to equip themselves with the skills that will be demanded by industry and business.

What is clear is that the organisations which have a concern for the maintenance of UK engineering as a world-class profession are not sitting back, but are making a significant effort to bring about change. This is not only a task for the professional bodies, however, but also for individual engineers. I firmly believe that it is up to all of us to make our own contribution to improving the public perception of our profession. The best way to achieve this is to stop moaning about status and recognition. Engineers have higher average salaries, higher representation in top jobs and lower unemployment than many believe, and the Council's recent research underlines this. Our status in many ways is as high – or as low – as we think it is, and if we hold our heads high, people will take more notice of us.

Malcolm Shirley CEng is the new Director General of the Engineering Council ♦

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MEETING NOTICE

One-Day Meeting and Workshop
(organised by the Environmental Noise Group)

EU Noise Policy

Is this the end of L₁₀ and L₉₀?

(It's Noise, Jim, but not as we know it!)

National Physical Laboratory, Teddington

Thursday 5 November 1998

As you may be aware, the EU has issued a Green Paper on noise and proposes to implement an EU-wide policy as soon as possible. As part of this process, a number of Working Groups have been set up with an individual conference having been held in Copenhagen at the beginning of September.

At this one day meeting, reports on progress so far will be presented in the morning session by the UK representatives; with the afternoon session comprising group discussions on the issues raised.

Those speaking will be:

- Martin Joseph (DETR)
- Ian Flindell (ISVR) - Working Group 1, Indicators
- Bernard Berry (NPL) - Working Group 2, Dose/Effect
- Paul Nelson (TRL) - Working Group 3, Computation and Measurement
- John Hinton (City of Birmingham) - Working Group 4, Noise Mapping

A buffet lunch and refreshments will be provided.
The meeting will close at 4.30pm.

CPD Certificates will be available.

EU Noise Policy, 5 November 1998

Name:

Organisation:

Address:

Telephone:

Fax:

Email:

☐ I enclose a cheque for the delegate fee

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☐ Member £95 + VAT = £111.63

☐ Non-member £125 + VAT = £146.88

Cancellations received after 16 October 1998 will be payable in full. Please return this form to the Institute office.

MEETING NOTICE

Environmental Noise Group
In conjunction with the South West Branch

Workshop on
Noise from Pubs and Clubs
University of the West of England, Bristol
Wednesday 11 November 1998

To consider progress on the proposed IOA Code of Practice on Noise from Pubs and Clubs and to receive ideas and feedback from professionals who have an interest in the topic.

There will be short presentations on the proposed code followed by the workshop sessions.

Programme

Buffet lunch

Introduction

PROGRESS TO DATE ON THE PREPARATION OF A CODE OF PRACTICE ON NOISE FROM PUBS AND CLUBS, John Hinton, *Birmingham City Council, Chair of the Working Group*

THE CODE OF PRACTICE – AN ENTERTAINMENT INDUSTRY'S VIEWPOINT, Eleanor McOrmish, *Brewers and Licensed Retailers Association*

RESULTS OF THE TRIAL OF THE PROPOSED NOISE LEVELS IN THE CODE, Mike Squires, *Exeter City Council*

Tea

Introduction to the workshop sessions

Workshop sessions

16.00 Report back from workshops

Close

Meeting Organisers: Stan Simpson MIOA, UWE, Tim Clarke MIOA, *Bristol CC*, Dawn Connor MIOA, *Basingstoke and Deane BCC* and John Hinton MIOA, *Birmingham CC*

Please note that the venue can only accommodate 50 persons. CPD certificates will be provided.

I wish to attend the workshop on Noise from Pubs and Clubs on 11 November 1998

Name:

Organisation:

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MEETING NOTICE

One-Day Meeting

Practical Aspects of Measurement Protocols

(Organised by the Measurement and Instrumentation Group)

National Physical Laboratory, Teddington

Tuesday 8 December 1998

This meeting comprises four workshop tutorial sessions, two in the morning and two after lunch. The nature of the workshops means that some prior exposure to the Standards covered would be an advantage. The sessions will describe the practical considerations necessary to achieve consistent results from a number of commonly used measurement protocols.

The workshops will be presented by members of the Measurement & Instrumentation Group on the following topics:

- Sound insulation and noise reduction in buildings. Calculation of the single number quantities from the source room average sound pressure level, the receiving room average sound pressure level and reverberation times. Procedures as in BS8233, BS2750 and BS5821.
- Industrial noise affecting residential areas. The determination of tonal and impulsive noise corrections with the measurement of residual and specific noise to obtain the Rating Level as in BS4142.
- Construction and demolition site noise control. Noise measurement to monitor the long term or transient level at the periphery of the site. The correct parameters to be reported as contained in BS5228.
- Verification of the performance of sound level meters in accordance with BS7580 Parts 1&2 and the calibration of the meter to confirm its performance before and after each series of measurements.

Meeting Organiser:

Martin Armstrong MIOA (Member of Measurement & Instrumentation Group Committee)
Brüel & Kjær (UK), Harrow Weald Lodge, 92 Uxbridge Rd, Harrow, Middx, HA3 6BZ

Certificates of attendance will be available for CPD purposes.

Practical Aspects of Measurement Protocols : 8 December 1998

Name:

Organisation:

Address:

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email:

Please register me as a delegate to the one-day technical meeting and invoice me for the meeting fee which includes lunch.

Members £95.00 + £16.63 VAT = £111.63 Others £125.00 + £21.88 VAT = £146.88

Cancellations received after 23 November 1998 will be payable in full. Please return this form to the Institute office.

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MEMBERSHIP

The following were elected to membership at the meeting of Council on 1 October 1998

Fellow

Dear, T A
Mitson, R B

Member

Asbury, A J
Asbury, A L
Barson, C
Cawley, J K C
Custard, G R
De Vos, P H
Deacon, M J
Freeman, J J
Hanson, M D
Highfield, M A
Hugin, C T
Marks, P E
Prior, M K
Ralph, D J
Richards, S D
Smith, R S
Sweet, M N

Treby, N D
Tuttle, H J
Warlow, S J
Williamson, C B

Associate Member

Appleton, A C
Blake, R J
Bradstock, P K
Brookes, P A
Brown, R J
Buckley, R R
Bull, S A
Collins, N J
Conroy, G D
Copley, C A
Cozens, J R
Cunningham, J R
Froud, M E
Gallimore, S
Gilbey, S G

Gilbey, T D
Ginnity, B M
Goddard, H M
Godman, A G
Gooch, D
Green, I M
Greenhalgh, P N
Hewett, K R
Hodgson, S C
Huffer, P N
Hume, R
Jones, M
Kelly, N C
King, L
Klek, S R
Land, I R
Lomax, J B G
Luke, A W
Manning, F J
Matthews, R C
Maudlin, J A
McDiarmid, A A

McIntosh, F M
Mellor, S A
Middleton, C J
Middleton, M S
Morris, K S
Norton, D M
Nothard, M
Parkinson, M T
Penny, J A
Phelan, J
Phillips, T A
Pickup, A R
Radford, J C
Reynolds, B S
Robertson, S Z
Sifakis, M
Simms, M E
Smart, A J
Smith, N L J
Southcombe, M J
Stopford, C
Swainston, J

Swankie, G N
Thomas, C
Upson, B S
Walker, H G
Wardle, W C
Wicks, I
Williams, C M
Williams, N J
Yates, P T
Yeung, B K
Young, G J

Associate

Carey, P J
Holdcroft, R K
McKeown, E P
Thompson, A J
Wallwork, N J

Student

Tan, M H

INSTITUTE DIARY 1998/9

1998

21 OCT

London Branch Evening
Mtg: Presentation by
Sue Bird, ANC
London

22 - 25 OCT

Reproduced Sound 14
Electroacoustics Group
Conference
Windermere

30 OCT

IOA CofC in Env Noise
M'tment exam
Accredited Centres

6 NOV

IOA CofC in W'place
Noise Ass't Advisory
Committee
St Albans

11 NOV

ENG & SW Branch
Workshop: Noise from
Pubs & Clubs
Bristol

12 - 15 NOV

Autumn Conference:
Speech & Hearing
Speech Group
Windermere

18 NOV

London Branch: Annual
Dinner. Guest Speaker
Frank Fahy
Shakespeare's Globe
Theatre

23 NOV

IOA Meetings
Committee
St Albans

3 DEC

IOA Membership,
Education Committee
St Albans

4 DEC

IOA CofC in
Environmental Noise
M'tment Advisory
Committee
St Albans

4 DEC

IOA CofC in Sound
Transmission in
Buildings exam
Accredited Centres

8 DEC

I & M Group Mtg
Practical Aspects of
Measurement
Protocols: NPL,
Teddington

9 DEC

London Branch Evening
Mtg: Active Noise
Control, Peter Wheeler
London

10 DEC

IOA Medals & Awards,
Council
St Albans

15 DEC

IOA Publications
Committee
St Albans

21 - 23 DEC

Sonar Signal Processing
Underwater Acoustics
Group Conference
Weymouth

1999

5 FEB

IOA CofC in W'Place
Noise exam
Accredited Centres

17 FEB

M & I Group
Workshop: DATII be the
Day
London

22 MAR

M* & I* Group One-day
Mtg: Good Practice in
Acoustical Measurement
Bristol

14 MAY

IOA CofC in W'Place
Noise exam
Accredited Centres

11 JUN

IOA CofC in Env Noise
Measurement exam
Accredited Centres

17-18 JUN

IOA Diploma exams
Accredited Centres

8 OCT

IOA CofC in W'Place
Noise exam
Accredited Centres

29 OCT

IOA CofC in Env Noise
Measurement exam
Accredited Centres

GARSINGTON OPERA FESTIVAL

Ken Ratcliffe FIOA, Ray Shack FIOA & Stephen Turner FIOA

The case of the open-air opera festival causing noise problems was well publicised in the national press. In this article, Ken Ratcliffe (ISVR), Dr Ray Shack (ADS) and Stephen Turner (Stanger Science & Environment), the consultants involved, tell the story.

Introduction

Garsington is a village five miles southeast of the centre of Oxford. Since 1989 Mr and Mrs Ingrams, the owners of Garsington Manor have organised performances of opera on summer evenings ('the Opera Festivals'). The operas are performed in the courtyard which, it was found, had excellent acoustic qualities for the purpose; staging and seating, for an audience of about 400, being brought in each year for these events.

The number of performances has increased over the years. Complaints about noise only commenced after the 1993 season in which there had been an increase in the number of events to fifteen performances and three dress rehearsals held over a period of about a month starting from about the second week in June.

The operas usually commence at 6.00pm with an interval of about 90 minutes to allow the patrons to picnic in the gardens or have dinner in the great barn. The performances end at about 10.00pm. The music is unamplified and over the years the festival has built up a good reputation, achieving critical acclaim.

The Problem

The sound from the opera mainly affects those who live along the nearby road, Southend, the closest property, Home Close, being some 70m to the rear of the stage. The opera is clearly audible in the large front and side garden of this property with the singing and the brass instruments being particularly dominant. The situation is exacerbated on fine still evenings, but on less clement days the intrusion is far less.

Following the complaints in 1993, the opera company commissioned Dr Ray Shack of Acoustic Design Services to carry out a series of noise measurements at a number of locations including Home Close, during the 1994 season. Ms Monica Waud, the owner of Home Close, commissioned noise measurements to be made at her property that year, and measurements were also carried out by Mr David Saffin of South Oxfordshire District Council. Following the 1994 season, Mr Ingrams was prosecuted by the

SODC for causing 'unreasonable disturbance'.

The prosecution was upheld in the Magistrates Court but overturned on appeal. No limits had been set by SODC, but Ms Waud's advisers suggested, as a guide, the use of the Noise Council's *Code of Practice on the Environmental Noise Control at Concerts* and stated that in their view a music noise level (MNL) exceeding the L_{A90} by about 5 dB(A) must be considered unsatisfactory.

In addition to the evidence from those affected by the opera noise, evidence was heard from local residents in favour of the opera festival. In the end the appeal was won on the problem of converting what are effectively planning issues into a criminal offence. The judge considered the note in para 3.3 of the Code of Practice: *The nature of music events means that these guidelines are best used in the setting of limits prior to the event to be 'peculiarly apt'*. The judge could not see the effect of the increase in the number of performances that had previously occurred and concluded that it was difficult to see anyone convicted of a criminal offence when his own conduct has been a mere repetition (in 1994) of that which had been regarded as lawful and formally unobjectionable in the previous year (in 1993).

1995

SODC granted temporary planning permission for 12 months in January 1995 allowing an increase to twenty performances plus three dress rehearsals but subject to the following noise condition:

No opera performance shall take place until sound attenuation measures have been implemented in accordance with a scheme which shall first have been submitted to and approved in writing with the Local Planning Authority. The scheme shall be submitted within two



Garsington Manor with the screens under erection

months from the date of this permission. The measures shall be retained for the duration of the opera festival and shall be designed to achieve a level not exceeding 2 dB(A) above the background level where the background level is the L_{90} level measured over a one hour period at the same time of day as the opera but when no performance (practice or other opera related activities) is taking place, and the measured level is the average of any 3 five-minute L_{eq} levels taken whilst the opera is being performed measured 1 metre from the façade of any dwelling.

The noise attenuation measures included heavy acoustic curtains with supporting structures designed by Ray Shack. During that season, SODC commissioned Stephen Turner of Stanger Science & Environment to assist them. His report stated that there was a noise problem to be addressed, particularly at Home Close, but that the options for noise control were limited. Unlike pop concerts, there was no means of controlling the noise as it occurred through an amplification system as none existed. Furthermore, measuring the Music Noise Level was not easy given the variable nature of the source superimposed on a variable residual noise environment, which, at times, produced L_{Aeq} levels well above the MNL.

1996

A planning appeal was heard before an inspector in April 1996 in connection with the conditions attached to

the permission granted for the 1995 opera season and, in particular, the noise condition. Noise evidence was prepared by Mr Saffin and Mr Turner for SODC, and by Ken Ratcliffe of ISVR Consultancy Services who had been commissioned by the Opera Company. The consultants agreed that with no specific guidance available the Noise Council Code should be used as a basis for assessment. With the number of events being 23 in the year, it was agreed that the criterion should be $MNL = \text{Background} + 10 \text{ dB(A)}$, lying roughly half way between 12 events (permitting Background + 15 in Table 1 in the code) and 30 events (permitting Background + 5 in Note 5 to Table 1 of the Code, albeit for indoor venues). It was also agreed that the guidance given in Note 4 to Table 1 of the Noise Council Code applied. This states that: *For those venues where more than three events per calendar year are expected, the frequency and scheduling of the events will affect the level of disturbance. In particular, additional disturbance can arise if events occur on more than three consecutive days without a reduction in permitted MNL.*

As the 23 events occurred over a period of a little more than one month, it was agreed that the criterion should reduce to $MNL = \text{Background} + 5$.

Stephen Turner further argued that in his view much of the disturbance arose from the variable nature of the opera noise. Such variation is not taken into account in the Noise Council Code which is primarily concerned with amplified music which has a much smaller dynamic range. Consequently, he argued that there was justifica-

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tion to reduce the criterion to a zero increase.

The Consultants also agreed that for the purposes of this assessment the maximum MNL at Home Close was 42.5 dB(A) but there was no agreement over the background noise level (the average L_{A90} over the four hour period of the performance) to use. The Opera company, based on previous limited measurements by SODC, said 37.5 dB(A), whereas SODC, following subsequent measurements, said that it averaged 35 dB(A) but could be as low as 31–32 dB(A). Using the Background + 5 dB(A) criterion, the Opera Company figures showed compliance, whereas SODC showed an excess, with on some nights that excess being as much as 10–11 dB(A).

Mitigation

The Inspector adjourned the hearing so that he could witness the 1996 season for which a further temporary planning permission had been granted. The Opera Company were aware that the attenuation measures needed to be improved from the 1995 season and the acoustic screening was extended and suspended on 'yacht' masts complete with winch mechanisms for raising and lowering the curtains. The detailed implementation of the design involving the lacing of the curtains to ensure adequate overlaps was found to be crucial. Strong winds tended to open gaps unless the lacing was carried out exactly according to the design.

In addition to further measurements of the opera noise being made during that season, tests were made of the barrier effectiveness and attenuation of 3–6 dB(A) was achieved at Home Close.

During the 1996 season the Opera Company sought planning permission for a seven year period. This was required primarily to enable the Company to plan ahead more effectively rather than relying on the assumption that the annual temporary consent would be granted. Consequently, when the Planning Inquiry reconvened in October that year it was to hear the case for the longer term planning permission.

The Inspector again heard evidence from a wide range of people including local residents supporting and opposing the event and some eminent people from the world of opera attesting to its artistic and cultural merit.

Inspector's Conclusions

In terms of the acoustic issues, the Inspector concluded:

- The MNL at Home Close was agreed as a design target to be 42.5 dB(A),
- The MNL should not exceed the background noise level by more than 5 dB(A),
- There was no agreement over the background level since Garsington Opera assumed an average of 37.5 dB(A), whilst SODC assumed 35 dB(A), but possibly as low as 31–32 dB(A),
- There may be occasions when the background noise at Home Close is indeed between 30 and 35 dB(A) but conversely, as he witnessed, there may be occasions when the noise from music and singing from the opera is so low as to be virtually inaudible,
- Improvements to the acoustic screen would provide

additional attenuation of between 1 and 2 dB(A),

- The typical current MNL was about 40 dB(A),
- The sound from the opera would be likely to be intrusive if a resident wished to sit quietly in the front garden of Home Close while an opera was being performed,
- Passing vehicles and motorcycles usually drowned out the sound from the opera,
- That intrusion from noise would occur from time to time in the nearest properties were permission to be granted,
- Account must be taken of how frequently the noise would be generated and how disturbing it would be, and the enjoyment of the participants should be balanced against nuisance to other people.

The Inspector found for the Opera Company and the Secretary of State agreed with the decision in early 1997.

1997

It has already been mentioned that one of the major differences in terms of noise control between these events and usual pop concerts is that there is no control over the source noise level. The MNL heard at the receiver is dependent in part on the source level which for these events depends on the nature and the orchestration of the work being performed. Furthermore, even after the Inquiry there was still uncertainty over the actual value of the background noise level. Consequently, during 1997, SODC through Stanger Science and Environment carried out a series of measurements to determine this issue.

Whilst the L_{A90} measurements were being made it became clear that the performances of an opera by Richard Strauss seemed more intrusive than any previous opera. This was due to the orchestration which involved some intense brass passages. Consequently, measurements were made to determine the MNL due to the Strauss opera and whether or not the criterion of MNL = Background + 5 dB(A) was being exceeded on the nights it was performed.

The weather during that part of the summer was relatively inclement and only on two nights were SODC certain that an exceedance had occurred. The measurements also indicated that the MNL had risen to 44 dB(A) for some 15 minute periods during the performances. This was higher than the previously assumed design target upon which the Inspector had based his decision at the Planning Inquiry. Because of the lack of control that they had over the source level and hence there being no certainty that such problems would not persist, SODC issued a Summons on the opera company, alleging that noise such as to cause an unreasonable disturbance to persons in the neighbourhood had been caused on two nights. The case was heard in the Magistrate's Court at the beginning of 1998.

Magistrates Hearing

SODC called four local residents to give evidence on their behalf followed by two environmental health officers and finally two of their consultants from Stanger Science and Environment, Stephen Turner and Jane Evans. The



View towards the auditorium area from Home Close. Screening not yet in place.

Opera Company called three local residents to give evidence on their behalf, followed by Mr Ingrams and Ken Ratcliffe.

A demonstration of the sounds recorded by Stanger on an O1dB's 'Symphonie' system was played to the Court. The intention was to give the Magistrates some indication of the relative sound of the opera compared to the other sounds within the noise environment. Although this form of support to evidence is unusual and can be questioned, no significant objection to its use was made by the Defendant. As agreed between both parties, it was made clear to the Magistrates that the sounds they would hear would not replicate the actual sounds as heard outdoors by the local objectors, but would provide an indication of what is heard.

The on-going problem of being able to measure directly the MNL arose again, and because the alleged levels had inevitably to be derived, the defence were able to query the validity. In general, because of the relatively inclement weather, the average background level that year was 37 dB(A), as had been previously asserted by the opera company. Consequently, the magistrate took the view what exceedance might have occurred was the result of the vagaries of the weather rather than by the actions of the opera company. Consequently, the case was dismissed.

SODC subsequently took the view that they had done all they could. Ultimately, it was felt by some to be an unsatisfactory conclusion because for a few people in Garsington, the Opera festival does cause some disturbance and does intrude on the use of their gardens at a time of year when the hours of daylight are longest. Conversely, the absolute levels from the opera are not high, the opera does not really cause intrusion on dull days and the opera festival is over by mid-July.

Conclusion

This case raised a number of issues:

1. The benefit of the consultants for the various parties working together as far as possible was demonstrated. They met on more than one occasion and determined

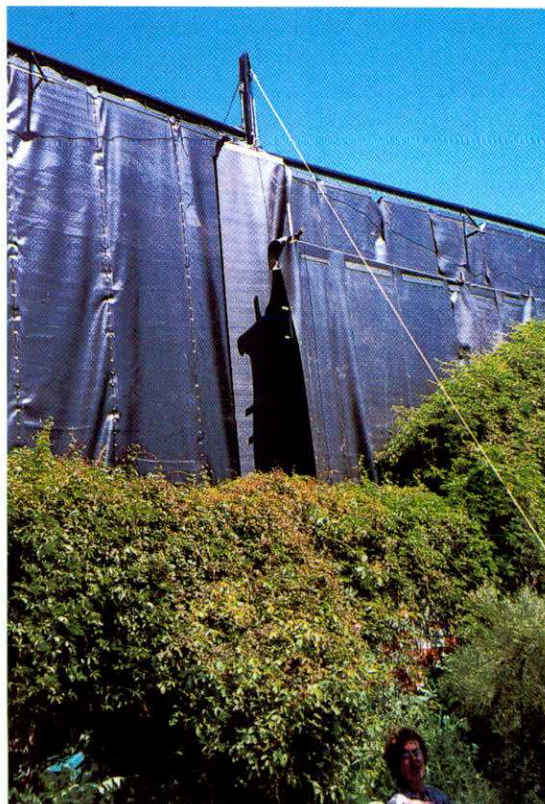
areas of agreement and disagreement. A document was produced for the Inquiry setting out these matters. This seemed to be welcomed by the Inspector as it enabled him to focus on areas of dispute.

2. Simply because it was not possible to measure directly the level of intrusive noise did not mean that there was not a problem. Conversely, it is clear that it is not appropriate to set noise conditions in the form of limits which cannot be directly tested. Some other form of control is required (eg agreement over barriers, hours of operation etc).

3. The age-old problem of desiring to use a single figure L_{A90} to describe the background level when a fairly wide

range actually occurs always presents difficulties. In this case, the Inspector/Magistrates were made fully aware of the variability and hence were able to make an informed judgement.

Ken Ratcliffe FIOA is at ISVR, University of Southampton, Dr Ray Shack FIOA is with Acoustic Design Services and Stephen Turner FIOA is with Stanger Science & Environment. ISVR and Stanger Science & Environment are members of the Association of Noise Consultants. ♦



Screens erected

AS QUIET AS THE GRAVE!

Philip Dunbavin MIOA

It was half past midnight and dimly dark. The distant street lights were just bright enough to illuminate my breath and the tombstones to my left. It was bitterly cold and every so often a very faint breeze would gently move the undergrowth in a disconcerting way.

Why, I began to wonder, was I stood in the dark, in a graveyard next to a disused chapel measuring noise levels? Perhaps unusual jobs just tend naturally to gravitate towards me. No, there were no sharks involved, however, there was a nightclub. Yes! I know it sounds unlikely. Perhaps I should explain by starting at the beginning.

The chapel has been derelict for many years. It has a listed façade and was once a very attractive building as can be seen in Figure 1. During its working life many of the chapel's congregation had been buried in graves running down the side of the building (see Figure 3). The front looks out onto a very busy town centre road whilst at the back is a car park. Buildings have been built on either side of the chapel hard up against the graves.

Figure 3 shows the chapel to the right with an office building and shop immediately to the left of the graves. This photograph was taken looking towards the road in front of the chapel.

The land had been bought by a developer with the intention of retaining the listed facade and converting it into a high quality nightclub. We had designed the nightclub to adequately contain the music noise and this was not an issue. The reason the project had gone as far as a Public Inquiry was the issue of people and vehicle noise due to patrons leaving the nightclub.

The road in front of the chapel, like most town centre

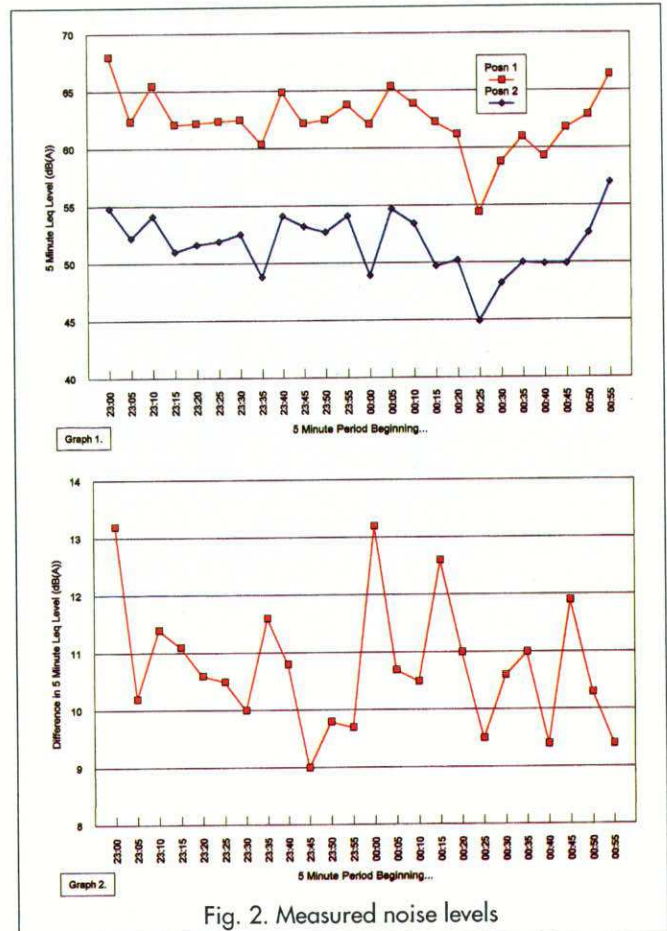


Fig. 2. Measured noise levels

roads, had a lot of traffic on it, both pedestrian and vehicular. The result was a very noisy environment into which the nightclub would add more of the same type of noise. The parameter we used to assess the noise climate was the L_{eq} value since the L_{10} , L_{90} and L_{max} values would be largely unaffected by an increased number of events.

We had predicted the effect of the additional cars and people and had prepared our case comparing these to a measurement of typically 62 dB L_{Aeq} at midnight. We were very puzzled to learn that the local authority had been on the site and had measured only about 52 dB L_{Aeq} at the same time of night.

Small discrepancies we could have explained as variations in the activities, however, a 10 dB difference was disconcerting to say the least. The local authority had measured the noise levels on the site level with the façade of the



Fig. 1. Listed façade of the chapel



Fig. 3. The disused graveyard

chapel. At first this sounded sensible and it wasn't until we caught sight of a photograph of where they had measured that the explanation became obvious. They had measured behind the 2.5 m high hoarding and were screened from the traffic on the street. Whilst such a screening effect is obvious to most acousticians convincing an inspector required that we get some proof.

So there I was in a graveyard, at midnight, measuring noise levels at two positions. The first above the hoarding at about first floor window height and the second behind the hoarding but level with the façade ie exactly where the local authority had measured. In Figure 2, Graph 1 shows the actual measured noise levels and Graph 2 the difference between them which was an average of 10.7 dB L_{Aeq} .

This evidence strengthened our case and the inspector subsequently ruled in our client's favour and granted planning permission. This was a most unusual survey, however, I can report that the only spirits I encountered were in the mini-bar later in my hotel room.

Four weeks later I found myself standing measuring noise levels in another graveyard halfway across the country. This, however, is a story for another time; I can tell you that so far graveyards fail the test of quietness!

Philip Dunbavin MIOA is Managing Director and Principal Consultant of Philip Dunbavin Acoustics Ltd, Vincent House, 212 Manchester Road, Warrington WA1 3BD.

Philip Dunbavin Acoustics is a member of the Association of Noise Consultants. ❖

ANC

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BRANCH MEETINGS

North-west Branch

Back in March 1998, John Hinton from the Environmental Service Department of Birmingham City Council, gave a professional, lively, colourful and very informative talk on local noise mapping. The talk was well attended by supporters of the procedure and sceptics alike (24 in total).

Initially a review of some large scale noise mapping surveys carried out in the UK and in other countries were presented. In addition the EC vision for the noise mapping of large European cities (population >350,000) by the year 2002 and for the harmonization of the standards/techniques used by the year 2006 was introduced.

An overview of the applications and benefits of such studies were presented.

The various computer-based mapping techniques available were discussed along with the one which is used for the noise mapping of the city of Birmingham which started in February 1998. The information required for such mapping and the problems associated with noise mapping such as the concerns of accuracy, verification, the extensive cost and the benefits of mapping were also discussed.

Finally a very lively discussion session was held until everyone decided it was time to visit the usual watering hole to continue a more informal meeting.

Many thanks to John for an interesting evening and once again to BDP for hosting the event.

The annual North-west Branch social took place on 1 August 1998 at Knowsley Hall, where the Royal Liverpool Philharmonic Society held their 'Music for a Summer Evening - Popular Classics' concert. 15 people booked to go on this visit but did not all manage to meet up. Hopefully all who booked managed to attend. The concert and fireworks were spectacular and the weather was mainly kind to all spectators.

Andy Turnbull MIOA

Eastern Branch

A very interesting evening meeting was enjoyed by members of the Eastern branch and their families when they visited Sizewell 'B' Power Station for a behind the scenes tour of the Pressurised Water Reactor (POOR) installation.

The visit was a very comprehensive one, beginning with a half-hour video of the design, construction and installation of the power station followed by a two-hour tour of the main reactor control room, turbine hall, sea water screening plant, diesel engine back-up generators for essential power items and the reserve sea water reservoir and cooling system. During the visit the many and varied questions were professionally answered by the tour guides.

Michael Alston MIOA

Midlands Branch

The autumn programme of activities kicked off at Birmingham University on 9 September with a talk by Gordon Dalgarno from Keele University. Gordon spoke to a small select band of members about his work in bringing music to the hard of hearing and the deaf and his efforts to develop systems to allow the physically handicapped to play expressive music. He particularly concentrated upon methods of increasing the awareness of music for the hearing impaired. Like much of acoustics, the results are obtained by a combination of high and low technology with the odd pinch of black magic. The high technology included a user-friendly computer system for the generation and manipulation of musical sounds that could be tailored for the individual listener to make the maximum use of any available hearing. Musical notes could be lengthened, shortened, separated, raised or lowered in pitch, tempo and volume. All of these effects were displayed in a dynamic full colour enactment of the music on the VDU. There is not space in this brief report to do justice to the interesting and stimulating content of the talk but everyone there found it one of the best talks that we have had at the branch. After the talk the members went down to the nearby 'Florence and Ferkin' public house where they were ably assisted by Selly Oak Rugby team in polishing off an excellent buffet.

The branch AGM will be on 3 November at Coventry. Four current Committee members have served their allotted three year spans but all are willing to stand for re-election so you can come along without any fear of being pressed into joining the Committee. The AGM will be followed by a talk from Peter Clarke of Proson Environmental Ltd on 'Pipeline Vibration'.

Mike Fillery MIOA ♦

Certificate of Competence in the Measurement of Sound Transmission in Buildings

The Institute of Acoustics is launching a new Certificate of Competence in the measurement of sound transmission through buildings. As with the other Certificate courses the course will be presented at a local centre. Assessment will be by a national examination set by the Institute and by a practical assessment during the course.

The date for the first examination is Friday, 4 December. Courses will generally run for 5 days up to 3 or 4 weeks before this date. Anyone interested in this course should contact a local centre. The centres that have expressed interest so far are;

Heriot-Watt University, Edinburgh (contact Professor R Craik); University of Derby, Derby (contact Dr M Fillery); Building Research Establishment, Watford (contact Mr J Seller)

Other institutions interested in offering this course should contact Professor R Craik or the Institute of Acoustics.

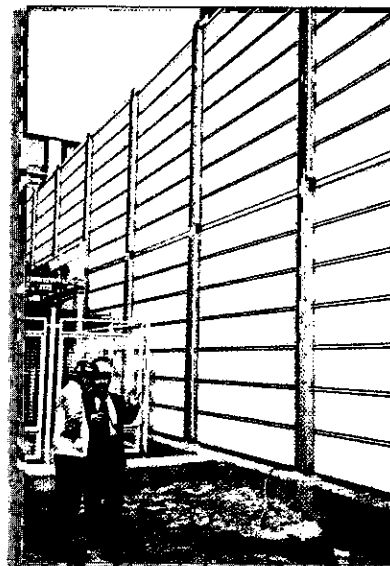


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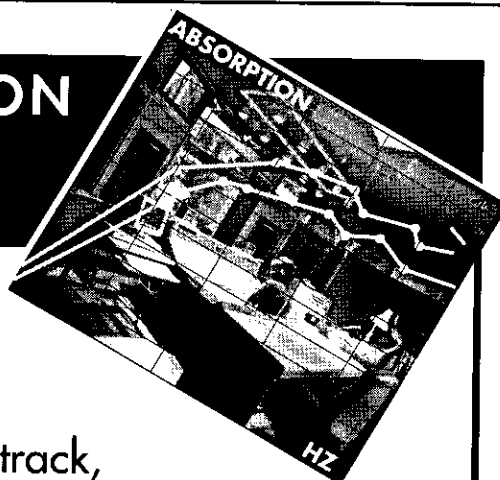
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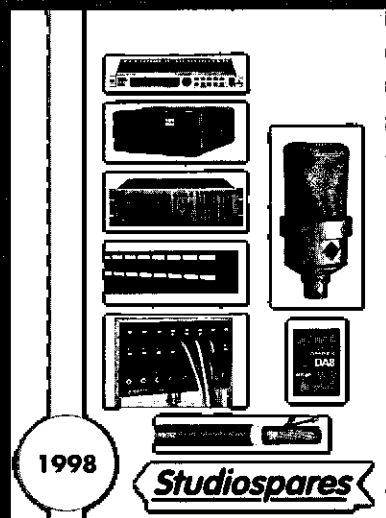
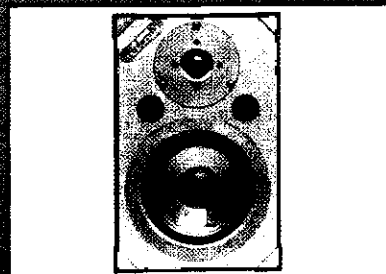
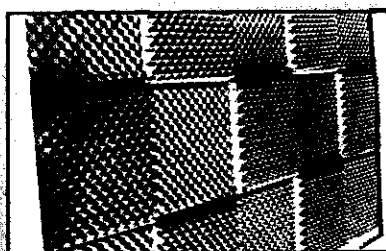
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30 July 1998

Noise Insulation

Mr Fitzpatrick: To ask the Secretary of State for the Environment, Transport and the Regions if he will list the decibel noise levels at which noise protection funding has been made available since 1968.

Ms Glenda Jackson: The Noise Insulation Regulations 1975 were made retrospective to roads opened to traffic on or after the 17 October 1969. The qualifying noise level as described in my previous answer has remained unchanged since it was originally introduced.

Mr Fitzpatrick: To ask the Secretary of State for the Environment, Transport and the Regions at what decibel level Government funding is available for noise insulation.

Ms Glenda Jackson: Government funding is available only in cases where the noise level is expected to exceed a specified noise level and to have risen by at least 1 decibel above the prevailing noise level as the result of the creation or alteration of a trunk road. The level of road traffic noise specified in the Noise Insulation Regulations 1975 (as amended in 1988) is 68 decibels measured as an average level exceeded for 10 per cent of the time between the hours of 6 am and midnight.

31 July 1998

Airport Noise

Miss McIntosh: To ask the Secretary of State for the Environment, Transport and the Regions, pursuant to paragraph 4.217 of the White Paper on Transport, when measures will be put in place to mitigate noise pollution from airports; and who will bear the cost of these measures.

Ms Glenda Jackson: Measures are already in place to mitigate noise pollution from airports. At Heathrow, Gatwick and Stansted certain such measures are prescribed by the Secretary of State under s78 of the Civil Aviation Act 1982; elsewhere, by airports either independently or by agreement with local authorities through the planning system. The costs of compliance are normally borne by the aviation industry, consistent with the 'polluter pays' principle. This principle will be integral to the airports policy, which we have undertaken in the White Paper to develop.

Road Noise

Mr Edwards: To ask the Secretary of State for the Environment, Transport and the Regions if he will make a statement on the proposals for noise mitigation measures on existing trunk roads in rural areas in the White Paper *A New Deal for Transport*.

Ms Glenda Jackson: The White Paper states that we are examining the scope for noise mitigation measures on trunk roads built before the current standards of road construction were created. The report on the review of trunk roads in Wales expands on this, explaining that a separate announcement will be made on revised criteria for dealing with requests for noise mitigation in such cases. The White Paper also announces a new policy of

considering the use of quieter road surfaces whenever a road needs to be resurfaced.

Mr Fallon: To ask the Secretary of State for the Environment, Transport and the Regions what resources are being made available to the Highways Agency for new measures to reduce motorway noise.

Ms Glenda Jackson: As indicated in the report *A New Deal for Trunk Roads*, a separate announcement will be made in due course about the budget to be made available for the Highways Agency to deal with the most serious and pressing cases and the new criteria to be used.

Extracts provided by Rupert Taylor FIOA

BSI News

New and Revised British Standards

BS 6840: Sound system equipment.

BS 6840-16:1998 Also numbered as BS EN 60268-16:1998. Objective rating of speech intelligibility by speech transmission index. Defines the STI, STITEL and RASTI objective methods for rating the transmission quality of speech with respect to intelligibility and the correlation of results from the different methods. Supersedes BS 6840-16:1989, which will be withdrawn on 1 January 2001.

BS EN Publications

BS EN ISO 11688: Acoustics – Recommended practice for the design of low-noise machinery and equipment.

BS EN ISO 11688-1:1998 Planning (ISO/TR 11688-1:1995) No current standard is superseded.

BS EN ISO 13090: Mechanical vibration and shock – Guidance on safety aspects of tests and experiments with people.

BS EN ISO 13090-1:1998 Exposure to whole-body mechanical vibration and repeated shock (ISO 13090-1:1998). Provides guidance on safety aspects of the design of equipment and the conduct of tests in which human test subjects are exposed to mechanical vibration and repeated shock. No current standard is superseded.

BS EN 50136: Alarm systems – Alarm transmission systems and equipment.

BS EN 50136-1-4:1998 Requirements for systems with voice communicators using the public switched telephone network. No current standard is superseded.

BS EN 50136-2-1:1998 General requirements for alarm transmission equipment. No current standard is superseded.

BS ENs Implemented by Amendment

BS EN ISO 8253: Acoustics – Audiometric test methods

BS EN ISO 8253-2:1998 Sound field audiometry with pure tone and narrow band test signals. Implementation of European Standard EN ISO 8253-2:1998 by amendment to BS 7636:1993.

British Standard Implementations

BS ISO 5348:1998 Mechanical vibration and shock – Mechanical mounting of accelerometers. Describes the mounting characteristics of accelerometers to be spec-

ified by the manufacturer and makes recommendations to the user for mounting accelerometers. Supersedes BS 7129:1989.

International New Work Started

IEC 61260 Electroacoustics – Octave-band and fractional octave-band filters. Will provide Amendment 1 to IEC 61260 to introduce EMC requirements.

Drafts for Public Comment

98/561746 DC prEN ISO 15667 Acoustics – Guidelines for noise control by enclosures and cabins (ISO/DIS 15667).

98/562367 DC ISO/DIS 15186-1 Acoustics – Measurement of sound insulation in buildings and of building elements using sound intensity – Part 1: Laboratory conditions (Possible BS ISO 15186-1).

Other Documents Not Issued as DPCs

ISO 5347-0:1987 Methods for the calibration of vibration and shock pickups – Part 0: Basic concepts. A non-technical revision of ISO 5347-0 is being prepared and will be issued under a new number as ISO 16063-1. In addition, the standard will contain a new informative annex A on the 'Expression of uncertainty of measurement in calibration' and an enlarged Bibliography as a new annex B.

ISO Standards

ISO 362:1998 (Edition 3) Acoustics – Measurement of noise emitted by accelerating road vehicles – Engineering method. Will be implemented as BS ISO 362:1998 to supersede BS 3425:1996.

ISO 10816-3:1998 Mechanical vibration – Evaluation of machine vibration by measurements on non-rotating parts – Part 3: Industrial machines with nominal power above 15 kW and nominal speeds between 120 r/min and 15,000 r/min when measured in situ. Will be implemented dual-numbered as BS 7854-3.

ISO Publications

ISO 10816-4:1998 Mechanical vibration – Evaluation of machine vibration by measurements on non-rotating parts – Part 4: Gas turbine driven sets excluding aircraft derivatives.

This information was announced in the July and August 1998 issues of BSI Update.

Guidance Document

New HSE Guidance on Noise Reduction Offshore

Practical guidance on reducing workplace noise in the offshore oil and gas industry has been published by the Health & Safety Executive (HSE).

Prepared by HSE's Offshore Safety Division, with assistance from Lloyds Register of Shipping and Acoustic Technology Ltd, the guidance is intended for managers, engineers, safety representatives and anyone respon-

sible for workers in situations offshore where noise is likely to present a risk to hearing, or to interfere with work or rest.

Following the format of guidance on manual handling published last year, the new publication comprises 59 case studies, giving real-life examples of how companies have reduced noise levels. These cover a range of offshore situations, including isolation, enclosure or other modifications to various plant and processes and protection of accommodation areas. Each study describes a particular noise problem, the solution(s) applied, the costs and noise reduction benefit achieved.

The publication also contains a managers' checklist, an illustrated chart showing typical sound pressure levels in different environments and brief details of duties imposed by relevant legislation, including the Offshore Electricity and Noise Regulations 1998, which came into force in February.

Noise exposure and the risk of hearing loss and other damage continue to be a significant problem in the workplace and each year several hundred compensation awards are made for occupational deafness due to past noise levels.

There are many areas offshore where noise occurs at levels which can cause hearing loss. Sharing the information resulting from the work done in these cases, should, HSE believes, help lead to a better understanding of how noise problems can be addressed offshore.

Copies of 'Sound solutions offshore: practical examples of noise reduction' (Ref. HSE182) are available from

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Law Report

Southwark London Borough Council v Mills and Others

Before Lord Justice Peter Gibson, Lord Justice Schiemann and Lord Justice Mantell

[Judgment July 29]

A covenant of quiet occupation did not impose on the landlord an obligation to alter or improve the premises. Accordingly, a local authority landlord was not obliged to provide adequate soundproofing for flats built at the end of the First World War which fell far short of modern standards.

The Court of Appeal so stated reversing by a majority, Lord Justice Peter Gibson dissenting, a decision of Mr Justice Laddie (*The Times* March 11, 1998; [1998] 3 WLR 49). The judge had dismissed an appeal by Southwark London Borough Council from an award by the Southwark Arbitration Tribunal dated August 1, 1997 whereby it determined that the covenant for quiet enjoyment in each tenancy agreement obliged the council to carry out effective soundproofing of 19 flats in Casino Avenue, Herne Hill.

The flats, built in 1919, fell far short of the standard

which would be required under present day building regulations. The tenants complained that they could hear the sounds of ordinary domestic life in neighbouring flats.

Mr Patrick Elias, QC and Mr Donald Broatch for the council; Mr Kim Lewison, QC and Mr Jan Luba for the tenants.

LORD JUSTICE MANTELL said that the council argued before the judge that the effect of the tribunal's award was to treat the covenant for quiet possession as imposing on the landlord an obligation to carry out a programme of effective soundproofing of the tenants' flats; that it would be bizarre if the standard covenant for quiet possession imposed on a landlord a greater obligation than he had undertaken through the repairing obligations in the lease so as to require the landlord to keep the property up to the standards of the present day; and that the law did not permit a covenant for quiet possession to be pressed into service for that.

Against that submission, counsel for the tenants cited the decision of the Court of Appeal in *Sampson v Hodson-Pressinger* ([1981] 3 All ER 710) and *Baxter v Camden London Borough Council* ([1998] 30 HLR 501) arguing that a landlord of two adjoining tenants might be in breach of the usual covenant for quiet enjoyment owed to each if the reasonable enjoyment of his home by each tenant was unduly interfered with by noise generated by ordinary use of the premises by the other tenant in the manner contemplated by the letting.

Counsel did not deny that to construe the covenant



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for quiet possession in such a way would in some cases give the tenant greater rights than under the covenant to repair and in many cases it would become indistinguishable from a covenant to improve.

The judge accepted that the two authorities cited were to the point and binding. Unencumbered by authority his Lordship would be reluctant to construe a covenant of quiet enjoyment as encompassing a promise to alter or improve the demised premises.

The covenant had to be read in the context of the agreement which sought to define the landlord's obligations to repair and maintain, and which also fixed the rent presumably by reference to the condition of the premises.

Also, as a matter of English usage, the traditional wording of the covenant not to 'interrupt' or 'interfere with quiet enjoyment' would seem to imply something done or not done by the landlord after the tenancy had been granted.

When his Lordship turned to authority he found some support for that first impression. In general at common law there was no implied covenant by the lessor of an unfurnished house or flat that the house or flat was or should be reasonably fit for occupation.

Moreover, the courts had been reluctant to impose a duty to repair under an express covenant if the effect of doing so would be to import an implied covenant to improve.

A case which was not cited before their Lordships or the judge, or the court in *Baxter* but which did seem to have a direct bearing on the question was *Duke of Westminster v Guild* ([1985] QB 688).

The plaintiffs had demised premises to the defendant and retained the adjoining land. A drain passing under the retained land but which only served the demised premises was discovered to be defective as a result of becoming blocked in that part where it passed under the retained portion. In an action to recover arrears of rent the defendant claimed to set off the expense of constructing a new drain.

On the trial of a preliminary issue as to whether the plaintiffs were liable to repair and maintain the drain, the judge held that the plaintiffs had an obligation under the lease to keep the drain in good repair and a duty to take reasonable care to keep the drain where it was not subadjacent to the demised property in repair and unobstructed.

The plaintiffs appealed. The appeal was allowed, the court holding that there was no implied covenant that the lessor was under an obligation to carry out the works of repair.

However, on the other side of the argument, there were three cases, two of which his Lordship had referred to already.

The third, *Sanderson v The Mayor of Berwick-upon-Tweed* ((1884) 13 QBD 547) was, incidentally, authority for the proposition that the covenant of quiet enjoyment might be breached when the ordinary and lawful enjoyment of the demised land was substantially interfered with by the acts of the lessor or those claiming under

him. But it was also important for its facts.

Although the mischief complained of in that case was very different in all other respects his Lordship found it impossible to distinguish the facts from the present case.

Sampson was cited to the Court of Appeal in *Baxter*. On any fair reading *Baxter* could not be distinguished on its facts from the instant case. If correctly decided or binding upon the court, it put an end to the argument.

So the dilemma was that there were two conflicting lines of authority both binding on the court. One, culminating in *Duke of Westminster v Guild* coincided with his Lordship's conclusion. The other terminated in *Baxter* and supported the conclusion of the judge in the instant case.

His Lordship had been unable to effect a reconciliation. Nor could his Lordship avoid the confrontation by reason of *Baxter* being a decision of a two-judge Court of Appeal.

His Lordship was very conscious of the fact that *Duke of Westminster v Guild* was not referred to in argument before their Lordships' court. In the end, however, his Lordship had come to the conclusion that *Duke of Westminster v Guild* was to be preferred.

Lord Justice Schiemann concurred and Lord Justice Peter Gibson dissented.

Solicitors: Ms Lyn Meadows, Southwark; Anthony Gold Lerman & Muirhead.

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Book Reviews

The Nature and Technology of Acoustic Space
Mikio Tohyama, Hideo Suzuki and Yoichi Ando
Academic Press 1995

ISBN 0 12 692590 9 £60.00

Three of Japan's leading acousticians have joined forces to write a book which will be of great interest to anyone involved in architectural acoustic design or acoustic signal processing. The book is a graduate level text which assumes that the reader has already a good basic knowledge of both acoustics and signal processing. The aim of the book is to introduce recent developments which are of relevance to the acoustics of enclosed spaces. Much of the discussion presented in the book revolves around modern signal processing techniques and their technological applications. However, a considerable part of the text is also devoted to a discussion of the subjective attributes of enclosed sound fields.

The book begins with a chapter on signal analysis. Again, a basic knowledge of this subject area is assumed, although some elementary concepts such as the discrete Fourier transform, correlation functions, and power spectra, are reintroduced. Much of the content of this opening chapter is devoted to the Hilbert transform and to time-frequency analysis methods. These subjects are briefly, but quite well introduced, and although the coverage is by no means exhaustive, sufficient detail is given to enable a further understanding of the work presented in later chapters.

The next substantial chapter describes sound propagation in an enclosed space. Again some basic concepts are presented, such as the effect of reflecting surfaces on the sound power output of the source, and the sound radiated by surface vibrations. Of most interest however, are the discussions presented on statistical aspects of room reverberation theory. The classical work of both Sabine and Eyring is first described within a statistical framework. Interesting discussions are also presented of the decay of sound in two dimensional and 'almost' two dimensional spaces and their associated reverberation times. However, perhaps the most important contribution of this chapter is the summary of the first author's most recent work on the statistics of room acoustic transfer functions. This is dealt with in terms of the poles and zeros of the transfer function, and some elegant results are presented which describe their statistical distribution. For example, the relationship between the phase response of the transfer function and the enclosure damping is clearly illustrated and described in terms of the distribution of non-minimum phase zeros.

The next chapter deals with the visualisation of the sound field in a room. The main content of the chapter is aimed at describing the distribution of intensity inside an enclosed space. As is well known, the intensity distribution in an enclosure exhibits some interesting characteristics and although this book demonstrates, for example, the circulation of energy, little further insight into the phenomenon is given. Nevertheless, there are some interesting features to be found in this chapter. In particular, the discussion of sound radiation from convex and concave domes, and the departure of the directivity of the radiation from that of a flat rigid piston.

The next chapter deals with the complex issue of the subjective response to sound fields and its physiological basis. The authors begin by introducing the independent physical attributes of the sound field which contribute to the acoustic response of a listener. These parameters include the autocorrelation function of the source signal, the impulse response of the room itself, and the head related impulse response functions of the listener. The interaural cross-correlation is also introduced as a significant measure of the interdependence of the two ear signals, especially with regard to the localisation of direct and reflected sound. The authors then go on to describe the four factors which they use in rating the subjective preference of a listening space. These are the listening level, the level of early reflections relative to the direct sound, the subsequent reverberation time after early reflections, and the interaural cross-correlation. The authors also assert that these factors are orthogonal, and that a single scale of preference can be devised by adding scale values of preference associated with each parameter. They demonstrate this approach by calculating contour lines of total subjective preference for various existing concert halls. Much of this discussion incorporates work previously published by the third author of the book. The chapter goes on to describe physiological mechanisms involved in processing binaural acoustic signals. This part of the work is necessarily

superficial, although worthy attempt is made to relate simple models of auditory signal processing to the subjective attributes that are identified earlier by the authors.

An interesting chapter on sound field control is then presented. This covers the general topics of controlling sound image localisation in sound reproduction, the design of inverse filters for enclosed spaces and the active suppression of unwanted sound. Again, the coverage of all these topics is a little sketchy, but nevertheless does give the interested reader a useful starting point for further reading in these subject areas. A good discussion is presented of the design of inverse filters for both the dereverberation of enclosed fields and for the 'transaural' reproduction of sound. The Multiple Input/Output Inverse Filtering Theorem (MINT) is discussed in some detail and shown to provide the basis of a digital filter design technique which leads to useful performance enhancements.

The final chapter deals with sound field control for concert hall acoustics. This begins with the design of loudspeaker and microphone arrays for improving speech intelligibility and discusses methods for its assessment. The influence of the precedence effect and signal attributes such as interaural time and phase differences are also described in some detail. The book closes with a discussion of methods for measuring in real concert halls the distribution of virtual image sources associated with room reflections and for designing 'howling' feedback cancellers.

In summary, there is plenty of interesting material in this book and it represents a valuable collection of mod-

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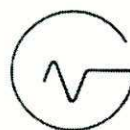
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ern acoustical research findings. A criticism of the work is that it is perhaps not as cohesive as it might have been, although bringing together the work described is clearly a considerable challenge. It is also true to say that the written English does not flow easily, but bearing in mind the nationalities of the authors, the writing is remarkably clear and free of grammatical error. One wonders how easy it would be to write one's own work to an equivalently high standard in Japanese!

P A Nelson FIOA

Digital Audio Signal Processing

Udo Zolzer

Wiley 1997, £45.00

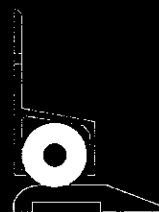
ISBN 0 47 197226 6

Many people teaching audio modules in degree courses will tell you that there is a real need for a good student text brimming with material on modern audio processing techniques. Udo Zolzer's new book, *Digital Audio Signal Processing*, is a valiant attempt to fill this void. Intended for engineering, physics and computer science students, as well as interested professionals working in studios and multimedia, Zolzer bases his material on an advanced course he taught at the Technical University Hamburg-Harburg. Frankly this shows: the book reads very much like a set of course notes, with all the positive and negative features that this implies. Zolzer compartments his material into a large number of small chapters. Early chapters focus on quantisation, analogue to digital (and vice versa) conversion, equalisers and the use of DSP devices in audio systems. We are plunged almost immediately into dry, nitty-gritty reference material; detailed system diagrams, standards specifications and derivations. The approach is mathsy and the written material is quite terse, aggravated by an aggressive sounding translation from the German. This is important material, and comprehensively covered. However, my feeling is that the no-nonsense approach may have worked well in Zolzer's notes for his own students – they could bang on his door and check their understanding of the more involved topics – whereas the lone student reader of this book may get left behind very quickly. The author is also pretty ruthless in terms of the prerequisite knowledge he expects of his readers; knowledge of systems theory, DSP and multirate signal processing. Later in the book, much of the more approachable material is treated in a way which is significantly more interesting for the reader. There are excellent chapters on Room Simulation, Dynamic Range Control and Data Compression which keep the treatment general, application-oriented and minimise the sums. A welcome chapter on Zolzer's own research in sampling rate conversion is also included. I have few reservations in including *Digital Audio Signal Processing* on the reading list for my students. However, despite the publisher's target audience, this is a text in which the excellent and dense technical treatment form a book to be referred to periodically and with other supporting material close at hand. Students and teachers must continue to wait for an approachable, tutorial book on the subject.

Michael J Evans ♦

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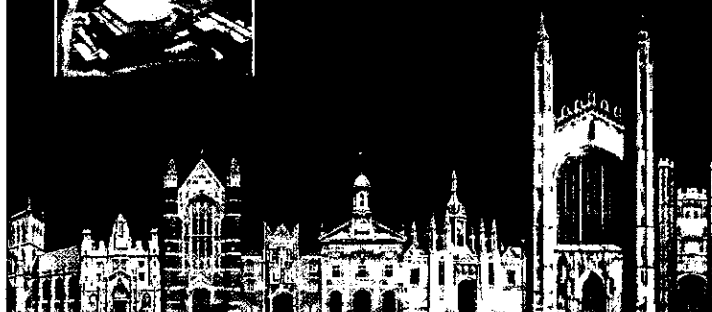
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The software package had also been specifically tailored for the UK market and includes calculation routines for CRTN, CRN, BS 5228 as well as international calculation standards such as ISO 9613.

In addition to traditional input facilities (keyboard and mouse), IMMI provides on-screen drawing plus interfaces to data formats like DXF, dBase and Arc View.

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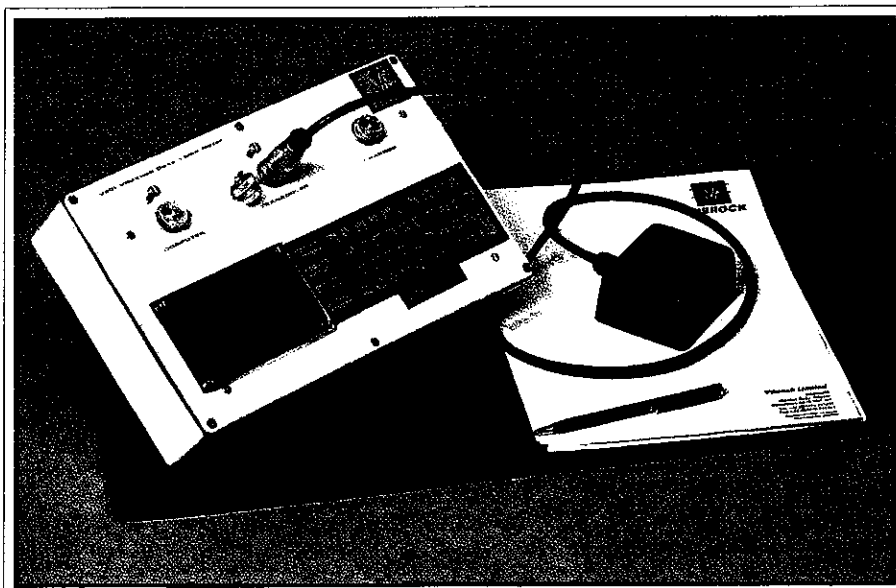
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Acoustic engineers in France therefore developed MICADO – a French acronym for 'Integral Method for the Acoustic Calculation of Obstacle Diffraction'.

The software is also ideal for modelling complex situations such as the repeated sound reverberation between a train and a noise barrier.

To predict the performance of the barrier by solving complex acoustic equations, so-called digital discretisation methods are used. These methods break down the behaviour of the barrier into a series of components smaller than wavelengths. In order to carry out the calculations and so determine the efficiency of the barrier in terms of dB(A), researchers have simplified some parameters and expanded on others.

The software means noise barriers can be designed using optimal shape and materials in collaboration with architects.

For further information contact Annick Mallen, French Technology Press Bureau Tel: 0171 235 5330.

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Salex Interiors Ltd, part of The Salex Group, has introduced the new Salex RT Suspended Absorber, an

acoustic absorber which is designed specifically for industrial applications, and is particularly suitable in large open plan factories.

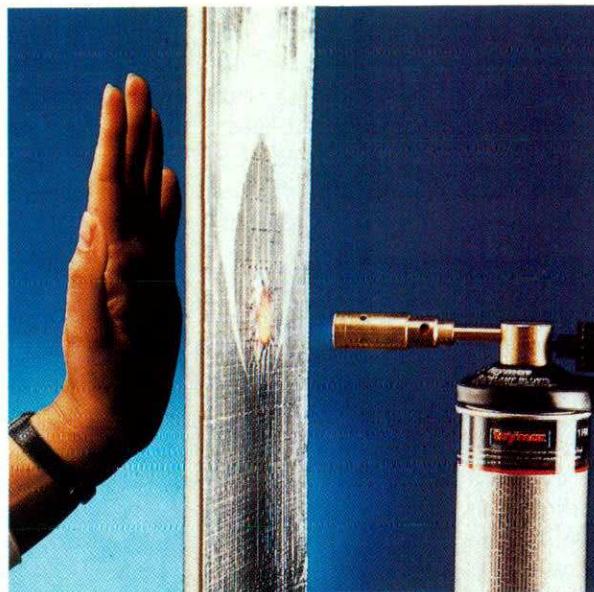
The absorber is a tough, durable product constructed from medium density glass fibre, which is encapsulated in a PVC-coated woven glass cloth enhancing its resilient, waterproof properties and thus preventing the ingress of water, oil and fuel.

The Salex RT Absorber also provides a light reflective surface to improve the effectiveness of existing lighting systems. Moreover the design helps to reduce the build up of airborne noise in enclosed areas, adding to its suitability in warehouses and other such environments.

Available in light grey or white, and weighing only 3 kg, the RT Suspended Absorber is washable using most industrial cleaning materials.

Mufti-lag Hygiena

Mufti-Lag Hygiena is a pre-



fabricated multi-layer acoustic insulation system for lagging ducts which does not use fibrous materials and is stated to be ideal for use in sensitive areas such as food and drink processing, pharmaceutical production and similar environments.

Despite its non-fibrous construction, Mufti-Lag Hygiena is said to offer all the proven benefits of standard Mufti-Lag – high quality acoustic performance, low thermal conductivity and fire resistance in accordance with Class 0 Building Regulations. Mufti-Lag Hygiena also resists oil and most solvents and will not age harden.

Produced from low toxicity melamine foam using a unique manufacturing process, the Mufti-Lag Hygiena range is available in 5 kg/m² or 10 kg/m² versions and in a choice of foam absorber thicknesses from 14 mm to 54 mm.

For more information on these products contact: Salex Interiors Ltd, Newcomen Way, Severalls Industrial Park, Colchester, Essex CO4 4YR Tel: 01206 508111 Fax: 01206 852795.

LMS INTERNATIONAL

LMS Roadrunner Mobile 1

LMS International has started shipping Roadrunner Mobile 1, a new addition to its Roadrunner family of products optimized for the collection and analysis of dynamic



data in the field. The Roadrunner Mobile 1 unit comprises up to 32 data acquisition channels, powerful real-time signal processing, and extensive post-processing facilities, all in a compact frame that can be run from a vehicle battery in the field, or by an ac power back at base. The software includes time, frequency, order, and real-time octave modules, making the product ideally suited to acoustics, rotating machinery and structural testing applications. Data are compatible with the LMS CADA-X system and with the Microsoft Office suite of reporting tools.

Unlike using a tape recorder for field work, the operator can perform a data analysis while still on-site. Any errors, such as an occasional channel overload, or a spurious reading from a rogue transducer, can be detected and corrected before return to base. The test strategy can even be refined while it is still in progress.

Roadrunner Mobile 1 is devel-

oped by LMS Skalar Instruments, a fully owned LMS subsidiary. The industrial design is shared with the recently announced SCADAS 111 from sister company LMS Difa Instruments. It consists of a lightweight, fully ruggedized base unit that measures only 180 x 365 x 440 mm (7" x 14" x 17"). It accommodates a powerful PC processor, four slots for I/O modules, a disc module dedicated for high speed data capture, and a tachometer module. A high resolution large flat screen and keyboard are also ergonomically integrated with the base unit.

The new Roadrunner Mobile 1 can be configured with four 4 channel input modules, providing 100 kHz sampling and 96 dB dynamic range.

These input modules support a variety of transducers, including voltage, ICP®, and microphone. The system can also be configured with a new 8 channel input module to increase the channel count in a compact frame. For more information contact Neil Kirtley, LMS International Tel: (+32) 16 384 562 Fax: (+32) 16 384 350 e-mail:neil.kirtley@lms.be

CIRRUS RESEARCH
CR 274 Octave Band Sound Level Meter
The CR 274 Octave Band



Sound level Meter from Cirrus Research provides all the measurements needed to comply with the Noise at Work Regulations, as well as allowing the frequency content of the noise to be determined. This can then be used to select the most appropriate hearing protection as well as in the provision of noise control measures.

The instrument can be supplied as a complete measurement kit, which includes a suitable acoustic calibrator, windshield and miscellaneous accessories in a carrying case.

For further information contact James Tingay, Cirrus Research plc, Acoustic House, Bridlington Road, Hunmanby, North Yorkshire YO14 0PH Tel: 01723 891655 Fax: 01723 891742 email:sales@cirrusresearch.co.uk

Cirrus Research is a Key Sponsor of the Institute.

KISTLER INSTRUMENTS New Vibration Monitor for Condition Monitoring

Kistler's new Vibration Monitor, type 5835A, is designed for the continuous condition monitoring of rotating machinery.

Vibration which can be caused

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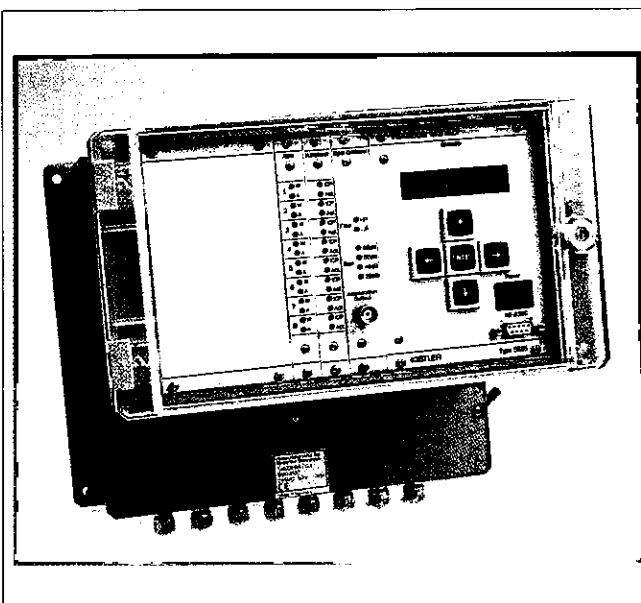
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HUFECOR

HUFECOR



The unit provides 16 independent channels. For each channel the monitor determines the rms value of the signal and compares it with the two threshold limits set by the user. When the vibration exceeds the limits it activates a relay switch either directly or via a variable delay circuit.

Kistler also manufacture a wide

range of ICP compatible sensors for use with the vibration monitor. In particular the new Vibration Sensor, type 8141A, has been developed for these applications.

For further information contact Chris Collins, Sales and Marketing Engineer, Kistler Instruments Ltd, Alresford House, Mill Lane, Alton, Hampshire GU34 2OJ Tel: 01420 544477 Fax: 01420 544474.

by imbalance, alignment errors, changes in the condition of bearings etc can indicate that maintenance is due or that a problem is imminent. By detecting increased vibration levels, costly manufacturing delays, damage or unscheduled downtime of complex machinery can be avoided. It also allows the user to determine when periodic maintenance is necessary.

INDEX DATA SYSTEMS

SNIFFER Acoustic Intensity Probe System

The IDS SNIFFER Intensity System offers a rugged system that is said to be accurate and easy to use. The system comprises a desktop PC, good quality sound card, SNIFFER probe with two microphones and the nVision acoustic intensity acquisition and mapping software.

All calibration may be done using the direct injection signal sources of the probe or by using the microphone calibrator. The user is guided by the nVision acquisition software module through the measurement sequence. When measuring is complete the intensity data object is computed automatically and presented for viewing in the Intensity visualisation module. Here 2D and 3D displays are available including a special spreadsheet that allows the user to see the effect of proposed changes.

The component parts of the system can be used for general purpose measurements and addi-



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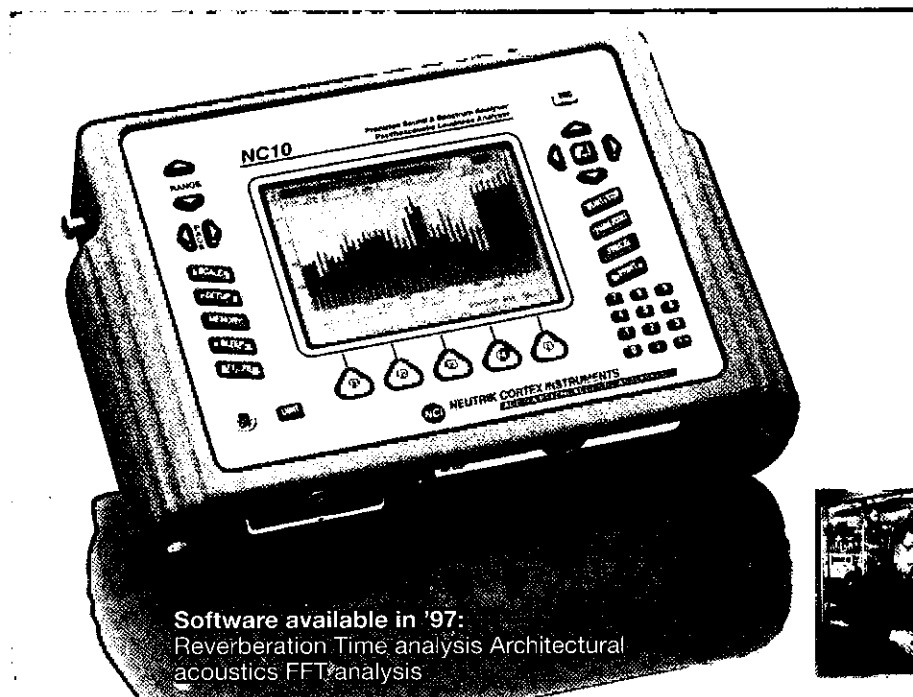
Acoustic House, Bridlington Road, Hunmanby,
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Acoustic Consultants

Hoare Lea & Partners Acoustics is an independent group within Hoare Lea & Partners, a long established practice of Consulting Engineers employing over 300 people in ten offices throughout the United Kingdom.

The Group provides consultancy to a wide range of noise and vibration projects, encompassing Building Services, Architectural, Environmental and Industrial Acoustics advice. Sustained growth of the core business has resulted in the following opportunities for individuals to contribute to and benefit from continued success.

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ACOUSTICS



tionally expanded for other tasks.

ADE - Angle Domain Editor

The analysis of noise and vibration signals from rotating or reciprocating machinery can be much simplified by moving from the time or frequency domains to the angle domain. This shift of domain allows signals to be interpreted with direct reference to the machine's cycle. Periodic events now regain their true significance allowing detection and analysis of defects to be rapidly accomplished.

The new nVision module ADE is much more than a tacho module; it is a full angle domain editor with comprehensive tacho repair and alignment features. Once the tacho signal is processed the multi-channel data can be edited, cut and pasted enabling signal synthesis and advanced 'what if' analysis. The ability within nVision to synchronise discrete data objects means that Time History, Spectrogram and Wavelet plots can all be locked and viewed together with joint cursors. Application areas range from Piston Slap to Brake Squeal.

HotRod 8-32

HotRod 8-32 for multi-channel acquisition and Sound Quality Processing provides 8-2 channels of 20-bit parallel-sampled ADC at 48k samples per second per channel for 24 channels continuously to disc, as many analogue output channels as you specify for input, all at 16 bit and full bandwidth, on-line digital filtering, sound quality metrics and signal processing features.

The system hardware comprises advanced multi-layer PC boards (8 channels per board), breakout boxes and a dedicated throughput disk. All channels are sampled in parallel and there are as many analogue output channels as there are inputs. This feature is said to allow creation of a true surround sound listening room where multiple

loudspeakers are available. Each output channel has its own digital filter and gain controls allowing spectrum shaping. During acquisition, the time history envelope for each channel is available for monitoring. All post-acquisition processing is completed in the new nVision 32-bit processing modules which deliver sub-2 ms FFT performance and many advanced features such as Angle Domain and Wavelet Processing.

For further details on these products contact Alan Bennetts, Index Data Systems Ltd, Crysna House, Main Road, Westhay, Somerset BA6 9TN Tel: 01458 860393 and 0836 230475 Fax: 01458 860693 e-mail: alanbennetts@compuserve.com

OSCAR ENGINEERING

SonaSpray K13

A new product, SonaSpray K13, is a versatile spray-on acoustic/thermal system, produced by ICC of Houston, Texas, which is said to have proven acoustic characteristics and to provide a simple, easily applied and cost effective means of significantly reducing noise reverberation in all types of manufacturing, assembly and processing areas. The absorptive qualities of SonaSpray K13 provide particular benefits in those situations where it is not 'reasonably practicable' to acoustically enclose noisy machines, such as punch presses and generated noise will not be increased by reverberation from walls and ceiling or roofs.

Oscar Acoustics have software that will calculate the existing reverberation times in any workshop space, based upon the building dimensions and construction fabric, then select the required SonaSpray thickness and the overall noise reduction that will be achieved by this treatment.

For further information write to the

company at Michaels Lane, West Yorks, Ash, Kent TH15 7HT Tel: 01474 873122 Fax: 01474 8795544.

NEWS

ACOUSTIC ASSOCIATES

New Link-Up

Four established independent Noise and Vibration consultancies, who have been working together for many years, have formed Acoustic Associates and are based in Peterborough, Leicestershire, Nottinghamshire and Humberside.

The consultancies involved are as follows; Acoustic Associates (Humberside) formerly known as Humberside Noise Management, Acoustic Associates (Leicestershire) formerly known as S & H Noise Consultants, Acoustic Associates (Nottinghamshire) formerly known as P Walsh & Associates while Acoustic Associates (Peterborough) will continue as previously.

Acoustic Associates offer a wide range of expertise based on the experience of the principal consulting engineers. All aspects of noise and vibration are covered including building acoustics, planning and environmental noise, industrial noise and vibration, vehicle NVH, aircraft test facilities, hand-arm and whole body vibration, entertainment noise, training, and expert witness.

Further information from Roy Pettit on Tel: 01733 896346 Fax: 01733 567779.

SYMONDS GROUP

Millennium Dome Acoustic Appointment

Symonds Group's acoustic department has been appointed as overall acoustic consultant for the Millennium Dome. The appointment marks the beginning of a close



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working relationship between Symonds Group and the Dome's owners, the New Millennium Experience Company, which will continue until the end of the year 2000.

Symonds' principle role will be to evaluate the acoustic properties of the dome. This information will then be used to advise on a sound distribution system for live theatrical and musical events, which will maximise sound quality and minimise noise pollution.

Symonds will also be providing advice on acoustics for the catering and retail outlets situated within the main dome. The aim here will be to reduce sound 'leakage' between the various areas to an acceptable level, ensuring that noise from one part of the site does not interfere with activities in another.

In addition, Symonds is working on strategies to reduce noise pollution in the area surrounding the site and so minimise the environmental impact of the dome on local residents.

For more information, contact Jim Griffiths FIOA on Tel: 01342 327161.

SOUND BARRIER SOLUTIONS

New Consultancy for Noise Barriers

A new consultancy, Sound Barrier Solutions Ltd was launched at the beginning of August. Based in Loughborough, SBS Ltd are noise barrier specialists for highways, rail and industrial projects of all sizes. With noise barrier design technology becoming an increasingly specialist field, SBS Ltd were formed to provide an independent and wide ranging service in barrier specification and design.

Director Giles Parker MIOA currently holds the Chair for both the Environmental Noise Barrier Association and the BSI committee for road barriers as well as heading the UK delegation to the CEN noise barrier working group.

Although it is still early days, SBS Ltd are already busy. Currently they are working with the Highways Agency on a noise barrier feasibility study in the North of England.

They are also investigating the use of low frequency noise barriers to cope with haulage vehicle noise for J Sainsburys' distribution centres. They are using similar techniques to help the South West Electricity Board deal with the low frequency noise from sub-stations.

Further information from Giles Parker MIOA, Sound Barrier Solutions Ltd, The Schofield Centre, Loughborough LE11 5AS.

LOCHARD PTY

Newcastle Airport Appointment

Newcastle Airport has appointed Lochard Pty Ltd of Melbourne, Australia, to supply and install a state of the art Noise and Track Monitoring System (NTMS) and is the second airport in the UK to use this latest technology.

The Noise and Track Monitoring System will use Lochard's GEMS technology connected in real time to the Airport's radar system. The NTMS comprises four permanent Noise Monitoring Terminals (NMTs), one mobile NMT, links to the flight information system, and a meteorological station. The system includes both noise monitoring and noise modelling, enabling the Airport to determine the future noise impact as the Airport expands.

A unique feature of the NTMS at Newcastle is the provision of a computer link between local schools and the system. The permanent NMT's will be situated at four local schools and each school will be able to access the system, via computers provided by Newcastle Airport. Similarly, Newcastle City Council and Castle Morpeth Borough Council will be able to access the system via modem links.

The installation of the NTMS forms part of Newcastle Airport's Noise Policy and Strategy. The computer links in the community will allow local people to be involved in the Policy as well as providing a contribution to local schools' technology and environment curriculum.

The mobile NMT will be used in a variety of locations on and around the Airport site to carry out research, address specific concerns from communities and monitor the

effectiveness of measures introduced to reduce the noise levels from the Airport.

The links from the radar and flight information systems, joined with the acoustic and meteorological data from the NMTs, will allow an accurate picture of the noise climate around the airport and the contribution made by individual aircraft types, operators and routes.

Further information from Phil Stollery on Tel: 01277 0973 Fax: 01276 0452.

CEL INSTRUMENTS

Wins HSE Order

CEL Instruments have secured an order for noise measurement instruments from the Health and Safety Executive.

The sound level meters will be used by the HSE's Field Inspectors to enable them to make checks on workplace noise emissions to comply with the requirements of the Noise at Work Act.

To meet the needs of the HSE for a simple device that required the minimum set-up time, CEL developed a special variant on the CEL424 Integrating Sound Level Meter. This was possible as the Hitchin-based company was an early adopter of flexible, micro-processor-based technology enabling many of their products to be configured for a wide variety of noise measurement applications. Mechanical switching has been replaced with icon-based keypads that allow a high degree of flexibility to be incorporated into the functionality of each instrument.

Designed to be simple to use, the CEL424's keypad icons are recreated on the instrument's screen, making the selection of measurement criteria an intuitive operation. When the instrument is switched on it goes through a Self-Test routine ending in a 'CAL' screen to prompt the user to carry out a calibration before making an assessment. After this has been completed the operator presses the 'Enter' key to display a default screen to measure Sound Pressure Level (SPL) with a default range of

70-140 dB(A). This range suits most industrial measurements but for quieter environments an alternative range of 50 to 120 dB(A) can be selected.

Up and down arrows allow the user to scroll through the other measurement options of an 'A' weighted equivalent average sound level (Leq), a 'C' weighted measurement (CPeak), a maximum level (Max) and a screen showing the duration time of the current measurement.

In standard versions of the CEL424 the instrument's microphone stem can also be replaced with a microphone and lead attachment that turns into an effective noise dosimeter which can be worn by workers to track their noise exposure during a working day.

For further information on CEL noise measurement products contact: CEL Instruments Ltd, 35-37 Bury Mead Road, Hitchin, Herts SG5 1 RT Tel: 01462 422411 Fax: 01462 422511 email:sales@cel.ltd.uk

CEL Instruments is a Key Sponsor of the Institute.

LMS DIFA INSTRUMENTS **ISO-9001 Certification**

LMS Difa Instruments has received full ISO-9001 certification for the design, development, manufacturing, supply, maintenance and support of its data acquisition systems. The ISO-9001 certification expands the ISO-9002 certification that has been in place at LMS Difa Instruments since February 1995 towards the design of the hardware as well as the software.

For more information contact LMS International on Tel: +32 16384 200 e-mail: info@lms.be.

NPL

New Laboratories Started

The development of new laboratories for the National Physical Laboratory got underway with a turf cutting ceremony conducted by Alastair Macdonald CB, Director General Industry at the Department of Trade and Industry.

The laboratories are part of a £300 million development at Teddington, during which most of the

existing NPL buildings will be replaced with state-of-the-art research facilities. NPL is the UK's national measurement standards laboratory and is a world leader in all aspects of metrology.

The redevelopment is being carried out under the Private Finance Initiative by Laser, a consortium of John Laing and Serco.

National Physical Laboratory is a Sponsor Member of the Institute.

FERGUSON & TIMPSON **Added Capacity**

Ferguson & Timpson have recently installed additional production capacity for the die-cutting and processing of noise control materials. Acoustic foam components for sound absorption are supplied self-adhesive backed with skin facings and can be edge sealed. In addition sound barrier and vibration damping materials are available and all noise control materials can be supplied fire retardant to various specifications including UL or MVSS. Individual die-cut components can be packed into kits to facilitate assembly.

For further information, contact Peter Timpson MIOA, 5 Atholl Avenue, Glasgow G52 4UA.

ARUP ACOUSTICS **Request for Comments**

British Standard 7385: Part 2: 1993. Evaluation and Measurement for Vibration in Buildings: PGuide to Damage Levels from Groundborne Vibration has now been in force for 5 years, and the committee is considering possible revisions. Comments are invited from members who have used the standard. These will be collated for consideration at the next committee meeting in January 1999. Please respond to Chris Manning FIOA, Arup Acoustics, St Giles Hall, Pound Hill, Cambridge, CB3 0AK.

CASTLE INSTRUMENTS

Free 4-Year Warranty Announced

Castle Group Ltd of Scarborough is now offering a free 4-year Warranty with all their products. Castle instruments are delivered with the standard 12month warranty and all customers have to do to receive an extra 3 years free, is fill in a simple

registration form and send it back to Castle by freepost. Once this has been done, they will receive a Warranty passport for each product purchased. This passport acts as a service book for the equipment and each year, when the equipment is serviced, the book is stamped, validating the warranty for another year.

This system is backed up by Castle's Premier Service, which promises customers, that wherever possible all service and calibration work will be carried out within 48 hours of receipt of the equipment and an official purchase order.

Further information from Castle Group Ltd, Salter Road, Scarborough YO11 3UZ.

Castle Instruments is a Sponsor Member of the Institute.

FABRITRAK

Relocation

Fabritrak announce their relocation to Unit 3, Canberra House, Corby Gate Business Park, Priors Haw Road, Corby, Northamptonshire NN17 5JE Tel: 01536 408844 Fax: 01536 408855.

IAC

New. Expanded Guide to Ventilation Duct Silencer Selection

Industrial Acoustics Company (IAC), of Winchester, Hants, has completely revised and updated its ventilation duct silencer application manual, with several new silencer designs appearing for the first time.

A key element of the revised publication is a condensed selection table which lists all of the silencers now available and provides a comparative standard by rating them according to their performance at a common 250 Hz. It therefore allows specifiers to make like-for-like comparisons between different silencer types, at a glance.

Contact IAC House, Moorside Road, Winchester, Hants SO23 7US.

IAC is a Sponsor Member of the Institute.

Items for this section should be sent to John Sargent MIOA, Oak Tree House, 26 Stratford Way, Watford, Herts WD1 3DJ ♦

PPG24 – Planning and Noise:

From Alan Bloomfield MIOA

The Editor

Dear Sir

Rupert Thornley-Taylor's Technical Contribution in the March / April issue, concerning clarification of PPG24, was welcome in many ways but raised some issues on which I would like to comment.

It would be helpful to give equal status to both calculation and measurement of road and railway noise. As it stands some interpret PPG24 as permitting only measurement, but Rupert Thornley-Taylor seems to be moving to the opposite extreme and suggesting that calculation should always be used, except in the narrow circumstances where measurement is permitted under the Calculation of Road Traffic Noise (CRTN) or the Calculation of Railway Noise (CRN).

While CRTN does permit measurement where it 'provides a more economic method...', CRN does not have an equivalent condition. In many cases, measurement will be the only practical means of categorisation, especially in the case of railway noise where the number of operators on a line can make it difficult to obtain the detailed data required. Given the number of planning applications potentially affected by significant levels of road and railway noise, in urban areas at least, some flexibility in determining the Noise Exposure Category (NEC) is necessary if applications are to be processed within the short time scales permitted by planning procedures. There may even be situations in which the only practical approach to determining the Noise Exposure Category is to extrapolate from noise levels measured elsewhere.

Similarly, the suggestion that road traffic noise should be determined by the use of hourly, rather than 16- and 8-hour, traffic flows raises a practical difficulty. I understand that measured hourly flow data are only available for relatively few roads (generally major routes – which are unlikely to be representative of other roads) and so for the other roads hourly factors must be assumed to be the same as for the major routes and applied to the recorded (usually 12-hour) census data.

As this assumption negates any improvement in accuracy which might come from the calculation of hourly L_{A10} values, the substantial extra work involved in calculating the 24 values, each corrected for the percentage of heavy vehicles, does not seem justified. A simpler approach would be to calculate the 16- and 8- hour traffic flows from the published census data and the (assumed) factors, and for the new guidance to offer revised formulae enabling the direct calculation of 16- and 8-hour L_{A10} values similar to Rupert Thornley-Taylor's suggestion for railway noise.

In dealing with the question of whether topographical features should affect the NEC, the approach suggested is that any design features which could only be

required by planning condition should be not be included in the categorisation. While this seems essentially reasonable, and avoids the potential 'logical absurdities' at low noise levels which Rupert Thornley-Taylor discusses, it appears to allow a converse anomaly at high noise levels. The only essential difference in the course of action between NECs C and D is that while for both permission should not normally be given, C does allow permission to be granted with suitable planning conditions. Suppose that, for example, a development falls into NEC D, but a noise barrier would reduce the noise levels to those falling within NEC C. The barrier would have to be required by a planning condition, but if the NEC is D permission should be refused outright as there is no provision for setting conditions where noise levels fall into this category. The result is that a development which, with a barrier, could be acceptable would still have to be refused permission. Unless the practical difference between NEC C and D is to be abolished, it would seem that topographical (as opposed to sound insulation) features – even if requiring a planning condition – should be taken into account in determining the NEC.

I also find it hard to follow the logic behind the suggestion that noise generated by the development itself should be excluded from the categorisation process. If the effect of intrinsic noise *mitigating* features of the development, such as a building which screens another, are to be included in the process, why should the effect of an intrinsic noise *source* be excluded?

A number of other issues requiring further guidance are raised by Rupert Thornley-Taylor but not resolved, one of particular concern is the question of whether Local Authorities should be able to require the applicant to carry out a PPG24 assessment. It would surely be unreasonable not to permit a Local Authority to require an applicant to provide an assessment, as there seems no justification why the potentially large costs of assessment should be born by the community at large which may not benefit from the development.

Tower Hamlets
Environment Group
Council Offices
Southern Grove
London E3 4PN

Rupert Thornley-Taylor FIOA replies

I am glad to have the opportunity of responding to the points which Alan has raised:

Calculation or measurement?

Measurement in the case of road traffic noise would need to be coupled to classified traffic counts and verification that the flows which occurred during the survey are a suitable basis for determining NEC categories. It would be simpler (and less prone to day-to-day variations) to use the prediction method. For railway noise, it indeed will usually be necessary to obtain SEL results for the relevant class of rolling stock from site measurements, but

the generation of L_{Aeq} levels is then most conveniently done by calculation taking into account train numbers and lengths. Detailed timetables, including freight, (usually no more than a year old) can be obtained from railway enthusiast organisations to whom Railtrack sell their old internal timetables.

Taking short cuts and extrapolating results from other sites may be expedient, but obviously if a planning appeal comes about, they will be open to challenge.

Hourly traffic flows

I agree that hourly flows may not be known. To make it possible to use the existing procedures Calculation of Road Traffic Noise (which gives only formulae for $L_{A10\ 18h}$ and $L_{A10\ 1h}$) it is simplest to generate the night time L_{A10} from the $L_{A10\ 1h}$ formula, if necessary by taking one eighth of the 8-hour flow if that is all that is available.

As Alan suggests, a better alternative would be to provide a revised formula, but this is not as simple as it seems. You might expect the difference between the result of calculating the $L_{A10\ 1h}$ and $L_{A10\ 18h}$ for the same value of Q and q (pages 39 and 40 of CRTN) to be $10 \log_{10}(18)$, but it is 0.5 dB more than that.

(Incidentally, I had a telephone call from a distressed noise consultant who had been told in a public inquiry that his results were wrong because he had not arithmetically averaged his L_{Aeq} results. The idea that the words 'The arithmetic average of recorded readings should be rounded up' in Annex 1 paragraph 8 implies that $L_{Aeq}(0700-2300)$ or $L_{Aeq}(2300-0700)$ should be derived by establishing hourly L_{Aeq} levels and arithmetically averaging them is preposterous. Period L_{Aeq} values should always be calculated according to the mathematical definition of the index. That being the case, those words have to be interpreted as referring to readings on different days, or in different locations.)

Topographical features

A noise barrier required by a planning condition would not change the Noise Exposure Category, so a site in NEC D would still be in NEC D even if a noise barrier required by a planning condition would reduce the noise levels to those falling within NEC C. External noise levels in NEC C, *after mitigation*, might not be good enough to justify permission where outdoor amenity space was involved.

Alan says 'if the NEC is D permission should be refused outright'. That is not what PPG24 says. It merely says 'Planning permission should normally be refused'. It does not say 'Planning permission should always be refused'. Several people who have attended the talks I have been giving about PPG24 have raised the problem of residential development in city centres, and PPG6 with its advice about residential use of space above shops. There are some highly desirable residential apartments in important city centre locations where external traffic noise levels are way above NEC D. Though not subject to PPG24, of course, are we saying that multi-million dollar apartments in Manhattan are really unfit for human habitation? Where there is no issue about gardens and amenity spaces, a

highly insulated, air conditioned dwelling can be appropriate.

The hard line approach of not changing NEC categories as a result of mitigation features should be complemented by careful interpretation of the words which attach to the categories in paragraph 1 of Annex 1. The advice attaching to NEC C applies to normal residential development of the same kind that is contemplated in NEC A and NEC B. The type of development that might be abnormal enough to be permissible in NEC D would be rather different.

Noise generated by the development

The NEC process is primarily for land use planning. The amount of noise generated by, for example, on-site roads, is dependent on the development, not on the circumstances of the site. On-site sources can certainly be the subject of conditions, but should not affect the NEC categorisation.

Who does the assessment?

I agree that it would be unreasonable not to permit a Local Authority to require an applicant to provide a noise assessment. Many do just that, and applicants see that it is not in their interest to refuse.

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Announcements

The Royal Society

Copley Medal awarded

Sir James Michael Lighthill FRS has been posthumously awarded the Copley Medal in recognition of his profound contributions to many fields within fluid mechanics, including important aspects of the interaction of sound and fluid flow and numerous other contributions which have had practical applications in aircraft engine design. He is also noted for his groundbreaking work on both external bio-fluid-dynamics - analysis of mechanisms of swimming and flying - and internal bio-fluid-dynamics, including flow in the cardiovascular system and the airways, and cochlea mechanics and other aspects of hearing. Sir James' widow will collect the Medal on his behalf.

ISCE

Voice Alarm Seminars and others

The Institute for Sound and Communications Engineers is following its recent meeting at the BBC's Wood Norton Conference Centre with repeat events at The Royal Society in London. The first, on 5 November will be for those responsible for the evacuation of a space. The second, on 9 December, is mainly for designers and installers. The recent British and International standards covering, inter alia, aspects of speech intelligibility will be examined.

The Institute is also offering two one-day training sessions on aspects of sound system design. Tuition for a Diploma in Sound System Engineering starts this month.

Further information may be obtained from the Secretariat, PO Box 258, St Albans, AL1 1QZ Tel: 01727 812312 Fax: 01727 841709 email cmrl@btinternet.com.

NSCA

Noise Awareness Day 1999

The National Society for Clean Air and Environmental Protection announce that Noise Awareness Day 1999, which will cover a variety of activities throughout the country, will take place on 7 July. Further information from Tim Brown at 136 North Street, Brighton BN1 1RG Tel: 01273 326313.

NPL Music Society

Colloquium announced

The Centre for Mechanical and Acoustical Metrology and the NPL Musical Society announce a Joint Colloquium entitled Music by Numbers to be given by Maurice Edmundson CPhys MinstP on Thursday, 29 October 1995, from 12.30 pm to 2 pm at the Stanton Theatre, Glazebrook Hall. Maurice Edmundson is a retired HMI and former secondary school headmaster who has combined a lifelong interest in keyboard music with his professional duties in teaching methods, educational technology, and the development of the use of computers in schools.

Visitors are welcome: please telephone to confirm. Organiser: Trevor Esward, Room 110, Building 59, CMAM, ext 6695, e-mail: trevor.esward@npl.co.uk.

Non-Institute Meetings

October 12-16, 1998: 136th Meeting of the Acoustical Society of America, Norfolk, VA, USA

Contact: Elaine Moran, ASA, 500 Sunnyside Blvd, Woodbury, NY 11797 USA; Fax: +1 516 576 2377; e-mail: asa@aip.org

October 15-16, 1998: Autumn Meeting of the Swiss Acoustical Society, Dubendorf, Switzerland

Contact: Swiss Acoustical Society, PO Box 8600, Dubendorf, Switzerland

October 31-November 3, 1998: AES International Conference: Audio, Acoustics and Small Spaces, Copenhagen, Denmark

Contact: J Voetmann, DELTA Acoustics & Vibration, Building 356 Akademivej, 2800 Lyngby, Denmark; Fax: +45 45 93 19 90; e-mail: jv@delta.dk

November 16-18, 1998: Inter-Noise 98, Christchurch, New Zealand

Contact: New Zealand Acoustical Society Inc, PO Box 1181, Auckland, New Zealand; Fax: +64 9 309 3540

November 20, 1998: Recreational Noise, Queenstown, New Zealand (In association with the above)

Contact: Grant Morgan, PO Box 76-068 Manukau City, New Zealand; Fax: +64 9 279 8833 e-mail: grantm@bitz.co.nz

November 22-26, 1998: Noise Effects '98, 7th International Congress on Noise as a Public Health Problem, Sydney, Australia

Contact: GPO Box 128, Sydney NSW 2001, Australia; Tel: +61 2 9262 2277, Fax: +61 2 9262 3135, e-mail: noise98@tourhosts.com.au

November 30-December 4, 1998: 5th International Conference on Spoken Language Processing, Sydney, Australia

Contact: Tour Hosts, GPO Box 128, Sydney, NSW 2001, Australia; Fax: +61 2 9262, 3135

March 15-19, 1999: 2nd Forum Acusticum and 137th Meeting of the Acoustical Society of America and 25th Meeting of the German Acoustical Society, Berlin, Germany

Contact: Elaine Moran, ASA, 500 Sunnyside Blvd, Woodbury, NY 11797 USA; Fax: +1 516 576 2377; e-mail: asa@aip.org

April 27-29, 1999: International Conference on Vibration, Noise and Structural Dynamics, Venice, Italy

Contact: D Hill, Staffordshire University, PO Box 333, Beaconside, Stafford ST18 0DF, UK; Tel +44 1785 353239, Fax: +44 1785 353552

June 21-24, 1999: 1st International Congress of the East European Acoustical Association, St. Petersburg, Russia

Contact: East-European Acoustical Association, Moskovskoe Shosse 44, St. Petersburg, 196158, Russia; Tel: +7 812 2919981, Fax: +7 812 1279323, e-mail: krylspb@sovam.com

November 1-5, 1999: 138th Meeting of the Acoustical Society of America, Columbus, OH, USA

Contact: Elaine Moran, ASA; Fax: +1 516 576 2377❖

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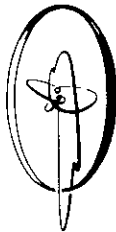
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