Institute of Acoustics

acoustics BULLETIN

Volume 19 No 1
January - February 1994

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contents

The Institute of Acoustics was formed in 1974 through the amalgamation of the Acoustics Group of the Institute of Physics and the British Acoustical Society and is the premier organisation in the United Kingdom concerned with acoustics. The present membership is in excess of one thousand seven hundred and since 1977 it has been a fully professional Institute. The Institute has representation in many major research, educational, planning and industrial establishments covering all aspects of acoustics including aerodynamic noise, environmental, industrial and architectural acoustics, audiology, building acoustics, hearing, electroacoustics, infrasonics, ultrasonics, noise, physical acoustics, speech, transportation noise, underwater acoustics and vibration. The Institute is a Registered Charity no. 267026.

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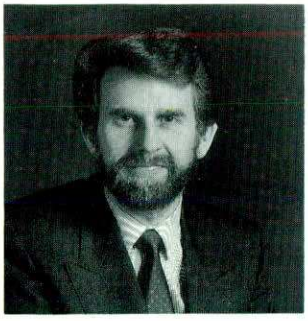

Dear Fellow Member

Greetings from sunny Salford where the first signs of Spring are in the air.

Easter brings the Spring Conference to Salford this year. The final programme will offer a wide range of papers. Let me remind you that the topics selected this year are hand-arm vibration, building/ architectural acoustics, active noise and vibration control, assessment of entertainment noise, occupational noise and hearing protection, impulsive noise measurement and assessment, instrumentation, measurement and quality, noise and sleep disturbance, aircraft noise and effects; there is still space for some late papers if you hurry.

It is encouraging to see a good number of papers coming forward under the provisions of the Institute's new refereeing procedures. I am confident that this will lead in time to an improvement in the standard of papers presented at our conferences.

At the Spring Conference we plan to hold a CPD forum giving members the opportunity to debate the issues that are raised in an article I have written for this issue of the Bulletin.

On a related topic, the Institute has been asked to nominate members who are Chartered Engineers or Incorporated Engineers to act as representatives on the professional review interview panels of the other engineering institutions. This is a good way for members to promote the Institute within the engineering profession without taking up too much time on a regular basis. If any members are willing to help they should contact Dennis Playle in the first instance through the Institute office.

The 1994 membership fee invoices have been mailed out along with a form to be returned for entries in the 1994 Institute Register. Remember that the 1993 entries will not be repeated unless we receive a copy of the form instructing us to do so. There should be one form per organisation, unless it is so large this proves unworkable, and the member returning the form should take care to check the details. Last year the number of names listed that were not actually members of the Institute was surprising! Inspecting the many forms that have been returned so far suggests that the recent general level of mobility of members seems to continue. The Register appears to have at least one clear use, that of showing where people surface from time to time!

After checking the responses on the 1993 fee forms, Council decided that payment by credit card or direct debit, although of interest to some and clearly beneficial in the case of a few members whose fee forms traditionally fall to the bottom of a vast pile of papers on their desks, involved procedures and indemnities that were cumbersome and expensive. So those proposals are shelved for the moment.

This issue carries information on the new Environmental Noise Group. I welcome the formation of the group committee and look forward to hearing more details of their programme.

See you at Salford in April.

Yours sincerely

Peter Wheeler.

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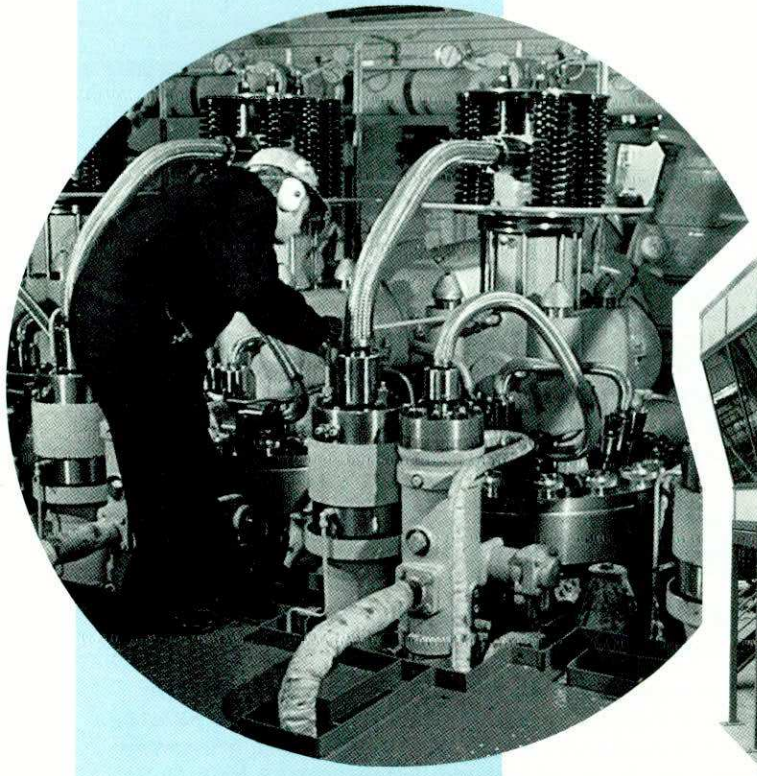

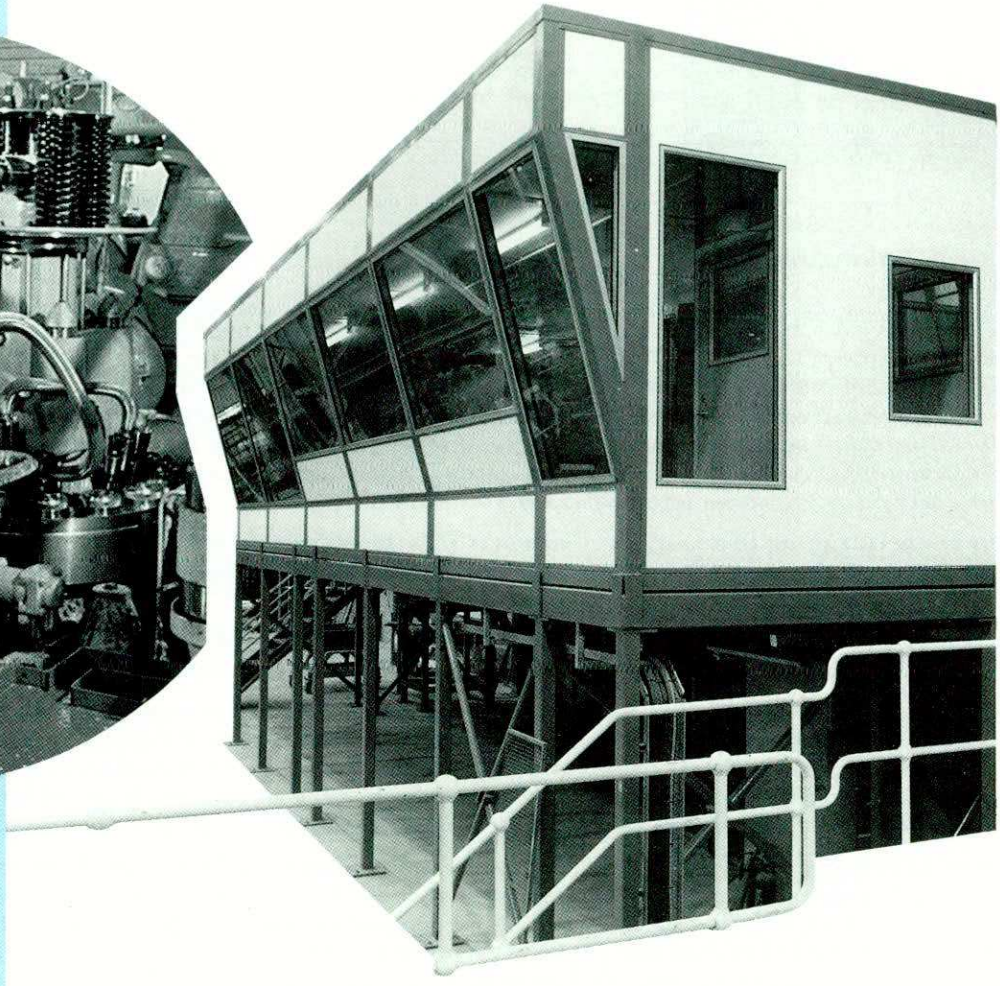

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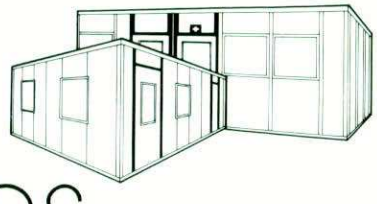

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REFLECTIONS ON THE FUTURE DEVELOPMENT OF NOISE POLICY IN THE EUROPEAN COMMISSION

Herbert Müller

Introduction

Future noise activities of the Commission of the European Communities in the area of environmental protection are laid down in the 5th Environmental Action Programme (EAP)[1] which was approved by the Commission and adopted by the Council in February 1993. Noise activities are presented in a condensed way in Table 12 of the 5th EAP (Vol II), see Table 1.

The objective 'no person should be exposed to noise levels which endanger health and quality of life' is in agreement with Art. 130r of the EEC-Treaty. Taking the definition of health as defined by WHO, it is for the scientific community of physicians, physiologists, psychologists, sociologists and acousticians to define 'a state of complete physical, mental and social well-being' in terms of noise impact. The EC targets up to 2000 are very ambitious. Column 2 of Table 1 shows that the Commission is willing to fight noise for the EC residents most affected by noise at all levels of legislation and administration (column 5). In column 3 actions are listed by which the targets of column 2 should be achieved. The further discussions shall be restricted to the actions: reductions of noise emission, standardization of noise measurement and ratings, noise criteria scheme for a noise abatement programme and measures related to infrastructure and physical planning.

Reductions of Noise Emissions

Vehicles

As you can see from Table 2, the reduction of permissible sound pressure levels of vehicles has been 5 to 9 dB since 1972 and this reduction will range from 7 to 12 dB by 1996 [2]. This may be considered as quite a success achieved in steps over 18 or 24 years respectively.

In traffic noise, motorcycles are normally not the most important factor with respect to L_{eq}, but very often emit the most conspicuous noise – especially, when they are accelerated with full power. There is at present a draft proposal [3] in discussion covering all technical requirements for two- and three-wheel vehicles – including the acoustical requirements of spare exhaust systems. The permissible sound levels for the different types of two- and three-wheel vehicles which are envisaged for 1997 are shown in Table 3. The values for motor cycles have already been drafted in a proposal of 1990. They were exactly the same values which had already been laid down in the directive 87/56/EEC[4] – but on a voluntary basis to the Member States rather than a mandatory one.

OBJECTIVE	EC TARGETS UP TO 2000	ACTIONS	TIME-FRAME	SECTORS/ACTORS
no person should be exposed to noise levels which endanger health and quality of life	Night-time exposure levels in Leq dB(A):			Transport + Industry
	exposure of the population to noise levels in excess of 65 should be phased out; at no point in time a level of 85 should be exceeded	inventory of exposure levels in the EC	before 1994	EEA + MS + *LAs*
		noise abatement programme to be set up	before 1995	*MS + LAs*
	proportion of population at present exposed to levels between 55–65 should not suffer any increase	further reductions of noise emissions (cars, trucks, cranes, mowers, etc). Directives to be presented progressively, aiming at implementation not later than 2000	before 1995	*EC* + MS + Industry
	proportion of population at present exposed to levels less than 55 should not suffer any increase above that level	standardization of noise measurement and ratings	continuous	EEA + *EC* + MS
		measures to influence behaviour such as driving cars, flight procedures, industrial processes operating at night time	id	*MS + LAs* + EC
		measures related to infrastructure and physical planning, such as better zoning around airports, industrial areas, main roads and railways	id	*MS + LAs*

Table 1: The EC workplan for noise as defined in the 5th EAP

	Poids t	Puissance	1972 dB(A)	1982 dB(A)	89/90 dB(A)	1996 dB(A)
Heavy goods vehicles	> 3.5 > 3.5 > 3.5	> 150 75 – 150 < 75	91 89 89	88 86 86	84 83 81	80 78 77
Light duty vehicles	2 – 3.5 < 2	- -	84 84	81 81	79 78	77 76
Buses & Coaches	> 3.5 > 3.5	> 150 < 150	91 89	85 82	83 80	80 78
Minibuses	2 – 3.5 < 2	- -	84 84	81 81	79(*) 78(*)	77(*) 76(*)
Passenger cars			82	80	77(*)	74(*)

(*) the limit values are increased by 1 dB if the vehicles are equipped with a direct injection diesel engine

Table 2: Emission values for vehicles

Vehicle	Vehicle category speed or cubic capacity	obsolete draft 1990			draft1993
		01.01.93	01.10.93	31.12.94	1.1.97
1. Two-wheel mopeds	≤ 25 km/h > 25 km/h	70 73	- -	- -	66 71
Three-wheel mopeds	-	78	-	-	76
2. Motorcycles	≤ 80 cm^3 > 80 ≤ 125 cm^3 > 175 cm^3	77 79 82	75 - 80	- 77 -	75 77 80
3. Tricycles	-	80	-	-	80

Table 3: Emission values for two- or three-wheeled vehicles

But despite the engineering success in reducing noise from motor vehicles, the noise impact (noise immission) to residents living near roads and highways has been raised because of the increase in the number and power of the vehicles and the use of wide tyres. This has been proved in several investigations, eg recently by Leuner [5]. Performing noise measurements in 256 sites, most of them residential areas, in 7 major cities and towns in Bavaria during night-time, he found an increase of 3.3 dB on average in comparison to noise measurements made 15 years ago.

As a result one can see that lowering the noise emission levels of vehicles only, is not sufficient to reduce noise impact on man. In order to protect man from noise we need noise quality criteria which must be carried through in the Member States.

Railways

There was a proposal for rail-mounted vehicles [6] ten years ago. It has not been pursued. As the railway lines for high-speed trains are being built now and in the future, a directive on the noise emission of rail-mounted vehicles must be considered as urgent. The Austrian regulation [7] on this matter could serve as a possible model for such a directive.

Aircraft

Initial action to reduce noise emitted from aircraft was taken by the European Community through the directive 80/51/EEC [8] amended by the directive 83/206/EEC [9] which phased out the oldest and most noisy airplanes (non-noise-certificated aircraft) by the end of 1986. The EC then prevented similar foreign registered airplanes from landing in the Community from 1988.

In 1982 the European Commission started detailed planning for a non-addition [10]/non-operation [11] rule for the next noisiest category of airplanes, the so-called Chapter 2 airplanes. The Directive 92/14/EEC[11] has laid down that 'Member States shall ensure that, as from 1 April 1995, civil subsonic jet airplanes fitted with engines having a by-pass ratio of less than two cannot operate at airports situated in their territory unless granted noise certification either': (a) to the standards of Chapter 3 airplanes; or (b) to the standards of Chapter 2 airplanes, provided that they were first issued an individual certificate of air worthiness less than 25 years previously.

There is a final cutoff date of 2002; all civil subsonic jet airplanes operating from airports of the Member States have to comply with the provisions of Chapter 3 aircraft. In a further step Chapter 3 airplanes will be considered. It is envisaged to reduce the requirements for that category of airplane by 3 dB.

Industry

A proposal has been drafted for a Council Directive on 'Integrated Pollution Prevention and Control' (IPPC) [12]. It deals with the emissions from industrial installations. Pollution is defined as 'the introduction by man, directly or indirectly, of substances, preparations, heat and noise into the environmental media...'. Considering pollution mainly as an introduction of substances into the environmental media, emission limit values can even be required for noise, generally stating that the emission limit values shall normally apply at the point where the emissions leave the installation. From an acoustician's point of view I would prefer to apply immission limit values according to the categories of areas in the neighbourhood of an installation and to compare the sound pressure level measured at the apartment or house of a nearby resident with the appropriate immission limit values. Such thoughts necessarily lead to the idea of noise quality criteria.

Construction Plant and Equipment / Machines Used Outdoors

In the field of construction plant and equipment there exist some Council and Commission directives for specialized types of machines. When these directives were made, the primary scope was to avoid barriers of trade rather than to protect the environment against noise.

As to the revision of the directive for earthmoving machinery [13], the Commission has approved of a proposal in which from 1996 the permissible sound power levels are to be reduced by 4 dB on average in comparison to the values of 1988 [14]. The revision of the directives for compressors, tower cranes, welding and power generators [15] is being prepared based on a study performed by Frenking [16]. Under reasonable assumptions for a usual distance between a construction site and a housing area and taking into account the permissible sound immission level for residential areas as existing in some Member States, Frenking suggested revised and, in my opinion, feasible values of permissible sound power levels to be used in a future amendment (see Table 4).

A Round Robin Test is going to be performed, to find out what procedure of measuring sound power levels of concrete hammers will be best, the one in which the

Air flow Q in m^3/min	Permissible sound power level	
	18 months	5 years
	after notification of the Directive*	
$Q \leq 5$	101	100
$5 < Q \leq 10$	102	100
$10 < Q \leq 30$	104	102
$Q > 30$	106	104

Air flow Q in m^3/min	Permissible sound power level	
	From 1 April 1996	From 1April 2000
$Q \leq 5$	97	95
$5 < Q \leq 10$	98	97
$10 < Q \leq 30$	100	97
$Q > 30$	101	99

Compressors (84/533/EEC) (Sound power levels in dB(A)/1pW):

	Permissible sound power level	
	18 months	5 years
	after notification of the Directive*	
Lifting mechanism	102	100
Energy generator	Levels laid down in the Directive on power generators according to the power generated	
Assembly comprising lifting mechanism and energy generator	Highest values of the two components	

	Permissible sound power level	
	From 1 April 1996	From 1April 2000
Lifting Mechanism (1) (P ≤ 17 kW)	97	95
(P > 17kW)	100	97
Energy generator	Levels laid down in the Directive on power generators according to the power generated	
Assembly comprising lifting mechanism & energy generator	Highest value of the two components	

Tower Cranes (84/534/EEC):
(1) P= installed power at the lifting mechanism in kW

Table 4a: The present permissible sound power levels of compressors and tower cranes, [15], in comparison to the values suggested by H Frenking [16].

mechanical energy is annihilated in a concrete block (present EC method [17]) or the other one in which this happens in a cylinder filled with steel balls (PNEUROP).

There is, however, a general concern in the EC Working Group on Noise and Vibration that it makes no sense to issue 2 or 3 Council directives per year on the permissible noise levels of some types of powered appliances. This would be a costly and expensive procedure and besides, only a few selected types of appliances would be covered by a directive, leaving most of the plant and equipment without any noise regulations. Several suggestions of the representatives of the Member States in the EC Working Group have been made. DG XI has envisaged the following solution – a framework directive issued as a Council Directive should be established requiring, that:

1 All machines used outdoors must be labelled with their sound power levels and their sound pressure levels at the workplace, if any. This should be valid for new machines put on the market after a certain date;

2 The operating condition during the acoustical measurement is the rated speed, if not otherwise specified in a Commission Directive;

3 The measurement results have to be communicated to the Commission; the Commission or its commissioned contractor performs an analysis of the measurements and publishes its outcome.

4 The Commission has the authority to issue Commission Directives concerning

a) the specific operation conditions during measurements taking into account existing standards (CEN, ISO etc.);

b) the setting of permissible sound levels for the future based on the continuously evaluated measurement results communicated to the Commission.

The main advantage of such an action is to be seen in the fact that all machines will be covered and, as Commission Directives can be more easily issued, that the directives can be adapted to the technical progress in a more flexible way. If the the Member States get the permission to grant tax incentives or 'user's advantages' for low-noise appliances, even market forces could be promoted to force the manufacturers to provide the market with low-noise machines.

Noise Criteria (Permissible Immission Levels)

To achieve noise quality control in order to protect EC citizens against unreasonable noise, a directive on noise

WINDOWS ON Acoustics

A NEWSLETTER FROM AcSoft JANUARY/FEBRUARY 1994

THINGS THAT GO BUMP IN THE NIGHT

The problem with automatic unattended noise monitoring is that although you can acquire huge amounts of sampled data, when the results are plotted, those peaks in the profile are not easy to identify, unless you were there at the time!

The new **dBTrig** software from French company **01dB** allows you to set a trigger level, above which the system stores the signal digitally on disk, without the need for a DAT recorder. The signal can then be played back when examining the measurement results, which are automatically annotated with the noise event.

For the first time, it is now possible to see if that mysterious peak in the noise trace was a car alarm going off, or a dog barking, or whatever, simply by listening to the signal.

This is just one of the unique features of the **ARIA** suite of software, which is now updated for 1994, and exclusively handled by AcSoft.

The system will plug into any PC which supports a 16 bit expansion slot, so laptops can be used, and the high-quality front end supports a range of traditional transducers like condenser microphones, already part of the acousticians toolkit.

ARIA is also the first computer based "sound level meter" to be type-approved by the strict authority PTB in Germany, and meets IEC 651 and 804 to Type 1P, with a suitable microphone, a range of which is also offered by AcSoft.

The heart of the system is an advanced plug-in card, around which 01dB have developed an unrivalled suite of software for acoustic applications, of which noise monitoring is just one. For those who are more traditionally minded, the software will also accept data which has been logged on a more conventional sound level meter, although it is a little risky to call the new SIP 95 from **Aclan** "conventional"! *(see later)*

The ARIA system installed in a lap-top computer, shown monitoring traffic noise .

There has always been a stigma associated with the use of computers for noise measurement and analysis, but the advances in personal computing in the last 2-3 years has been nothing short of staggering, with 486 PCs becoming commonplace, when 286s were thought of as fast only two years ago. The corresponding value for money means that more effort can be put into critical components, to give a truly integrated measurement system, for significantly less investment than a less versatile instrument, with no upgrade path. The PC has grown up, and the measurement possibilities with it.....

Circle 1 & 2 on the faxform (back page) for more information.

EDITORIAL

The new year sees a new force in the world of acoustic and vibration measurement.

Building on a wide base of experience and selecting a broad but compatible range of products from smaller and more flexible companies, AcSoft *offers a real alternative to traditional measuring instrumentation.*

Using platforms configured on personal computers (either notebook, laptop or desktop), with dedicated hardware for the critical requirements of high quality measurements, coupled with industry standard user interfaces, such as Microsoft Windows®, the systems capitalise on the huge advances in desktop computing in recent years.

This issue introduces some of these new products and profiles the companies and personalities behind them.

AcSoft - A Quiet Revolution....

A new company has emerged onto the sound & vibration marketplace, with a simple mission - to provide measurement solutions for noise & vibration problems, based on flexible modular architectures, along with the support and advice needed to enable customers to get the most benefit from their investment.
This approach comes naturally to the company's founder, John Shelton, as it has proved successful in the past with his previous company Brüel & Kjær, for whom he worked 11 years both in UK and in Denmark.
"AcSoft came about because we felt that emerging technologies based on PC architectures were being largely overlooked, and clearly they provide flexibility hitherto unseen in dedicated stand alone solutions such as analyzers and sound level meters. However, the technology itself is not the answer, as it must be coupled with a high level of support, and knowledge to enable the less computer-literate user to benefit". AcSoft is comfortable with these needs, and using building blocks from reputable suppliers such as **01dB, Aclan, CETIM, Aksud** and **Ziegler Instruments,** complete systems can be configured, to suit the customers' exact needs at surprisingly low cost.
"Traditional resistance to PC solutions is now decreasing, with easy-to-use programs using Windows™, and perhaps more importantly in our marketplace, systems have now been type-approved under IEC standards, and can be calibrated accordingly".

John Shelton of AcSoft

To discuss your specific measurement requirements, call John on 0296 662852 or send off the enclosed fax form.

Vive le SIP !

Don't log it, SIP it!

An elegant new sound level meter is available from **Aclan**. Called the SIP95, it is an easy-to-use Type 1 meter which will find its main application in datalogging environmental noise. It comes with a huge standard memory of 256,000 data values, that's nearly 9 hours at 8 samples/second, or nearly 3 days at 1 sample/sec for example. Both L_{eq} and Peak values can be stored, and the statistical distributions can be calculated.
Set up is via a clear two line LCD, and the user is led through an easy series of questions, before the meter starts the measurement. Three coding buttons can also be used to annotate the measurements, when particular events occur, and when the data is downloaded to a PC via the standard RS-232C link, the noise profiles are marked with these codes.

Options include waterproof cases for long-term monitoring, a programmable octave filter set and different software can be uploaded to the SIP from a PC for other measurement functions, guaranteeing upgrade possibilities in the future.

For further information on le SIP, circle number 3 on the fax form.

Noise Prediction

As well as measurement instruments and systems, AcSoft is also able to offer two powerful prediction software packages, both developed by **CSTB**, a leading acoustics institute in Grenoble.

Mithra is a package for the prediction of outdoor acoustics, calculating noise levels from new industrial developments, roads or railways. Starting with a map of the area, the user can input such parameters as topography, buildings, road or rail traffic levels, absorption, etc. and calculate the effects of barriers, for example. The user interface can be mouse driven, making the software very easy to use, and this, together with speed of calculation and accuracy, makes Mithra an essential tool for the highway planner or consultant.

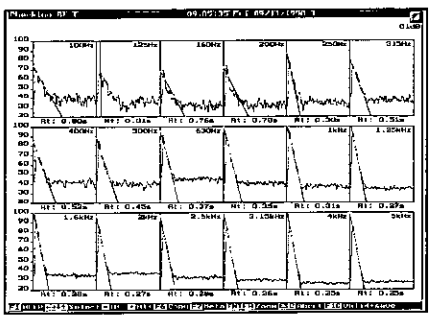
Epidaure is for prediction *of indoor* acoustics, where the acoustic consultant can optimise e.g. an auditorium with respect to EDT, RASTI, reverberation time, by mapping these on to the layout of the room. Again, the user interface makes the software a pleasure to use.

For more information and demo disks, circle 4 for Mithra and 5 for Epidaure.

Building Acoustics needn't be a pain in the back....

We've all been there. Getting to that address and finding that the transmission loss measurements have to be made in a flat on the 6th floor. And the lift is out of order. Unfortunately, it's a fact of life that powerful sound sources tend to be heavy, but a new source from Aclan conveniently unclips into two easily manageable parts (less than 16kg), consisting of the speaker, and the generator/filter/PA. The **GDB 95** is a very cost-effective unit, offering pink, white and filtered noise, with battery operation and some novel remote control options, including infra-red.

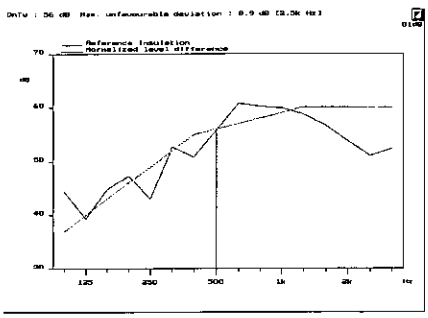
The GDB is one of the accessories we can supply (there's even a tapping machine) for building acoustics measurements according to **BS2750** and **BS5821**.



Measuring reverberation time using dBIsol

The software packages **dBIsol** and **dBRw** are options to the ARIA system, and guide the user through the measurements of source, reception and background noise measurements with an advanced algorithm for reverberation time determination, from impulses or noise cut-off.

For more information circle 6 on the faxform.



Calculation of D_{nTw} using dBRw software

L_n's in ⅓ Octaves ? - be serious!

Well, if you can do L_n and ⅓ octaves, what about both. At the same time?

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All you need is the **dBFete** software option for ARIA, which not only logs noise with time, but also its spectral content. By choosing a point on the trace, the spectrum can be viewed. Spectral L_n's (a new phrase?) can also be calculated for selected time periods.

The answer is yes - what was the question?

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For more information circle 8.

Zéro Un dé Bé - Who ?

01dB, or zero one dee bee to we British, are no newcomers to the world of acoustics measurements. Although they are little known on this side of the Channel Tunnel, the company is the leading supplier of environmental noise measurement systems in France - yes even ahead of you know who. This success is based upon the approach of the founders, Patrick Luquet and Adam Rozwadowski, to serving the needs of the customer, with flexible computer based instrumentation. Pioneers of the Short L_{eq} technique, they are both respected acousticians, serving on several standards committees.

The time has now come for 01dB to expand, and a new "filiale" has been set up called 01dB Industries, headed up by Jacky Dumas, previously the top acoustics man at B&K France. No, this is not an ex-B&K mafia. Simply a recognition that there is a choice when it comes to high quality noise & vibration measurements.

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01dB has linked up with other suppliers, and co-developed hardware and software with companies like Aclan for sound level meters, Aksud for probes & calibrators and OROS for dedicated PC cards. These relationships ensure that the systems are truly integrated, so we can offer a complete measurement solution.

If you are interested in more information on 01dB, circle 7 on the faxform

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The complex indicators required in this standard are calculated, and the user is guided to "hot spots" to ensure that sufficient measurements are taken to fulfil the selected accuracy. Contour, colour scale and vector plots are also available.

ARIA supports a choice of intensity probes, from Aksud, Hewlett Packard and of course B&K, via a suitable power supply.

For more information on Intensity measurements, circle 9.

This subject will be the key feature in the next issue of Windows on Acoustics.....

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3 **SIP95** Type 1 datalogging sound level meter, and options

4 **Mithra** external noise prediction software with demo disk (3½" HD unless specified)

5 **Epidaure** architectural acoustics modelling software with demo disk

6 **dBIsol** and **dBRw** building acoustics software with accessories

7 More information on **01dB** - warning, some is in French!

8 **dBFete** processing software for L_n's in ⅓ octaves

9 **Intac01** intensity measurement software

10 **X-YS** range of FFT analyzers from Ziegler

11 Other . . . . . .

F F F F Fast FFT !

A new range of lightning fast FFT analyzers is now available in the UK from **Ziegler Instruments**. Based on plug-in PC cards, systems can be configured from **2 to 16 channels** with a variety of software options.
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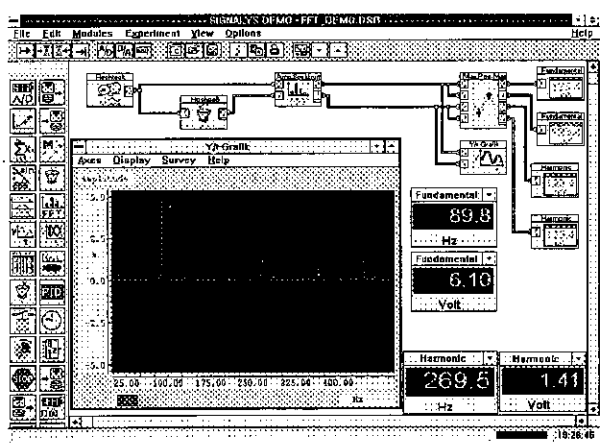
SIGNALYS, a Windows™ based toolbox, which allows the user to design his own analysis system from blocks such as Generators, filters, FFT and displays, great for quality control & educational applications, with an attractive flow diagram layout.



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All of the systems are modular, and can be scaled by adding a DSP piggy back card, for extra power hungry applications. The front ends support transducers with ICP® powering, and offer a truly flexible solution for straightforward engineering investigations, and quality control applications.

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Nominal maximum welding current	Permissible sound power level	
	18 months	5 years
	after notification of the Directive*	
Not greater than 200 A	104	101
Greater than 200 A	101	100

	Permissible sound power level	
	from 1 April 1996	from 1 April 2000
	97	95

Welding Generators (84/535/EEC):

Electric Power (P)	Permissible sound power level	
	18 months	5 years
	after notification of the Directive*	
P ≤ 2 kVA	104	102
2 kVA < P ≤ 8 kVA	104	100
8 kVA < P ≤ 240 kVA	103	100
P > 240 kVA	105	100

Electric Power (P)	Permissible sound power level	
	from 1 April 1996	from 1 April 2000
P≤ 2 kVA	95	92
2 kVA < P ≤ 240 kVA	97	97
P > 240 kVA	99	99

Power Generators (84/536/EEC)

Table 4b: The present permissible sound power levels of welding generators and power generators, [15], in comparison to the values suggested by H Frenking [16].

criteria must be set up. As discussed above, the establishment of permissible emission levels of noise sources is not sufficient. The noise emission of a source is only one factor, often a very important one, influencing the noise impact. But other factors may also be important, eg the frequency of noise events, distance and, in the case of road or rail traffic, the condition of the road or track surface. When considering noise criteria the following subjects have to be discussed and clarified:

- choosing the most suitable descriptors for defining a noise situation, following ISO 1996 as closely as possible (L_{eqA} for day- and night-time, maximum level of single noise events, assessment of conspicuousness of noise in respect to frequency and time fluctuation)
- review of noise quality criteria from selected countries; as a result of this review a scheme of noise quality criteria (permissible noise immission levels) may be proposed
- quantification of existing and future extent of noise exposure in the EC Member States
- how the competence between the Community and the Member States should be shared
- a cost/benefit analysis of the expenditure for noise abatement in relation to the depreciation of sites and properties, if no common EC directive on noise criteria comes into force.

The noise quality criteria should represent a minimum standard for all citizens in the EC. Individual Member States may have stricter values. Following the Swiss noise regulation [17] as a possible model, three types of noise immission levels are imaginable: planning cases, existing situations and alert cases – the latter comparable with the 65 dB(A) – value in the 5th EAP.

This value may represent a criterion for the necessity of redevelopment of inhabited areas.

Attention should be particularly drawn to publicly funded projects. Here one cannot be satisfied with just an environmental impact assessment (EIA), even if it includes noise, but uniform action against noise on the basis of CE noise criteria appear indispensable.

Reflections on Subsidiarity and EC Noise Policy

As is well known the meaning of the expression subsidiarity is twofold [18]. Firstly, the responsibility for legislation or administration should be transferred to a level/unit as low as possible. Secondly, the superior level of legislation or administration must take over the responsibility from the lower level, if at the lower level the required task cannot be accomplished. As to the permissible noise emission levels of appliances, this is clearly in the responsibility of the EC. Otherwise barriers of trade would endanger the internal market.

As to noise quality criteria, one might consider noise

as a problem of short distances, in most cases not ranging beyond 1000 meters. One might argue, that it should be left to the individual Member State to decide how much noise they allow for their citizens without affecting their health and well being. As a consequence it is to be feared that noise problems fall by the wayside because of the different priorities an individual EC state has set.

For these reasons a directive on noise criteria on Community level would prove more efficient. From an estimation prepared for WHO [19] one can conclude that more than 10% of the inhabitants in Europe suffer a noise exposure of more than 65 dB(A) during daytime – an exposure which most people classify as highly annoying. As noise affects human health and well being in diverse ways, noise abatement is a serious task for the EC. This is in conformity with Article 130 r of the treaty on European Union stating: 'Community policy on the environment shall contribute to pursuit of the following objectives . . . . – protecting human health . . .'.

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This article, which forms the basis of a paper presented at the 1993 Autumn Conference in Windermere, reflects the personal opinion of its author.

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A NEW LOOK AT INTELLIGIBILITY IN STANDARDS: Report on the IOA Panel 'Intelligibility Requirements for the Revision of IEC849'

John M Woodgate

The following paper, 'A new look at intelligibility in standards' was presented at 'Reproduced Sound 9' in October 1993, but was inadvertently substituted in the Proceedings, Volume 15 Part 7, by another paper, presented as part of the training course held during the Conference.

Appended to the paper are the texts of the documents prepared by the IOA Panel as working documents for the revision of the speech intelligibility text of IEC849, and the revision and expansion of IEC268-16. At the IEC TC84 meeting in Athens in November 1993, it was agreed to set up a new Working Group (WG3) to deal with both the revision of IEC268-16 and the revision of IEC849, and Philip Pratt (based in Surrey) was appointed Convener of the Working Group and Project Leader for the two revision projects.

Appendix 3 is a brief report prepared by Peter Barnett of a workshop discussion that took place at the Institute's ninth annual Reproduced Sound conference in Windermere during October 1993. A number of delegates with an active interest took part in the discussion which was led by John Woodgate and Peter Barnett.

This publication in the Bulletin is to encourage a process of wide consultation of IOA members on the subjects concerned, and constructive comments are invited. They should be sent to the Institute office for transmission to Peter Barnett who is the chairman of the working party.

Introduction

IEC849: 1989 Sound systems for emergency purposes was published in 1988, but work on the standard had actually begun in 1982 in IEC technical sub-committee SC29B, which merged with SC60C to form technical committee TC84 in 1983. Part of the reason for this long gestation time was certain difficulties within the committee Secretariat, reflected in the standard being published with a substantial printing error.

For the first time, this standard imposed a requirement for the intelligibility of speech signals produced by a sound system. This was made possible by the previous (but nearly contemporary) publication of IEC268-16: 1988. The objective rating of speech intelligibility in auditoria by the 'RASTI' method, which standardises the RApid Speech Transmission Index procedure. While the work on IEC849 was promoted by two Continental countries (possibly because legislation was being planned), the latter standard was, naturally, promoted by Dr Brüel, leader of the Danish National Committee delegation to SC29B, since his company had invested in the production of the 3361 Speech Transmission Meter specifically to bring the results of the research by Houtgast and Steeneken [1] into the domain of sound system engineering. The involvement of British acousticians and sound system designers in the preparation of these standards was vanishingly small, because no such people were made available by industry to take part in it.

The publication of IEC268-16 as BS6840-16:1989 produced, as expected, no reaction, but the publication of IEC849 as BS7443: 1991 produced an unexpectedly large and vocal reaction. To a great extent, this points up the general change in attitude to standards that took place in the sound industry at that time, much of it prompted by the publicity surrounding the EMC (Electromagnetic Compatibility) Directive.

While IEC849 seems to satisfy other countries, it was soon accepted in Britain that a revision was necessary, mainly because the text is too vague, and some interpretations would either be very costly or even impossible to fulfil. Normally, a Panel of BSI Technical Committee EEL/32 would have been created to prepare a draft, but at the time EEL/32 had three very active Panels already, so it was agreed that the Sound and Communication Industries Federation (SCIF) would organise a Panel, with representation of all industry sectors concerned, to do this work. This Panel found it possible to prepare a revised draft, with the exception of the text on intelligibility. At the time, there were moves within the Institute of Acoustics (IOA) to increase involvement in standards work, on a co-ordinated basis. It was therefore agreed to set up a Panel under IOA sponsorship, of suitable experts to deal with the intelligibility requirements in the proposed revision. Meanwhile, it had been pointed out [2] that the underlying IEC268-16 was less than satisfactory, at both theoretical and practical levels, and the Panel therefore decided to propose a revision of this standard as well. Formal New Work Item proposals were submitted to the IEC through EEL/32 in June 1993, and the draft revisions are expected to be discussed at the IEC TC84 meeting in Athens in November of this year. Normal procedure would be to set up a new Working Group of TC84 to deal with these proposals, and if this is agreed, the British committee has someone willing to act as Convener (see foreword).

In international work, it is always uncertain that success will be achieved, but the procedures described above are the correct way to improve a standard which is found, for whatever reason, to be less than satisfactory. Above all, it is essential that the appropriate people, with expertise and/or influence in the industry, should take an active part in the work.

The Starting Points

The intelligibility requirement in IEC849 could not be stated more simply. It requires a Speech Transmission Index (STI), measured by the RASTI method, of 'greater than or equal to 0.5'. Stated like this, without any qualification, the way is open for the requirement to be applied overstringently, say at a point 7 m above the floor, directly behind a substantial pillar, while the audience at a boxing match is in full cry! Alternatively, a measurement at one point, 3 m from a loudspeaker on its axis, at 2.30 am, achieving a result of 0.51, could be claimed as meeting the requirement. Furthermore, it is considered inappropriate to ignore all the other methods of determining speech intelligibility, particularly since RASTI (and full STI) cannot be used with some common types of signal-processing, such as compression, in operation.

In IEC268-16, the chief concerns are its restriction to 'auditoria', with no clear definition of 'auditorium' (for example, is a roofed sports stadium an auditorium?), and the purely qualitative nature of the text on 'limitations of the RASTI method'.

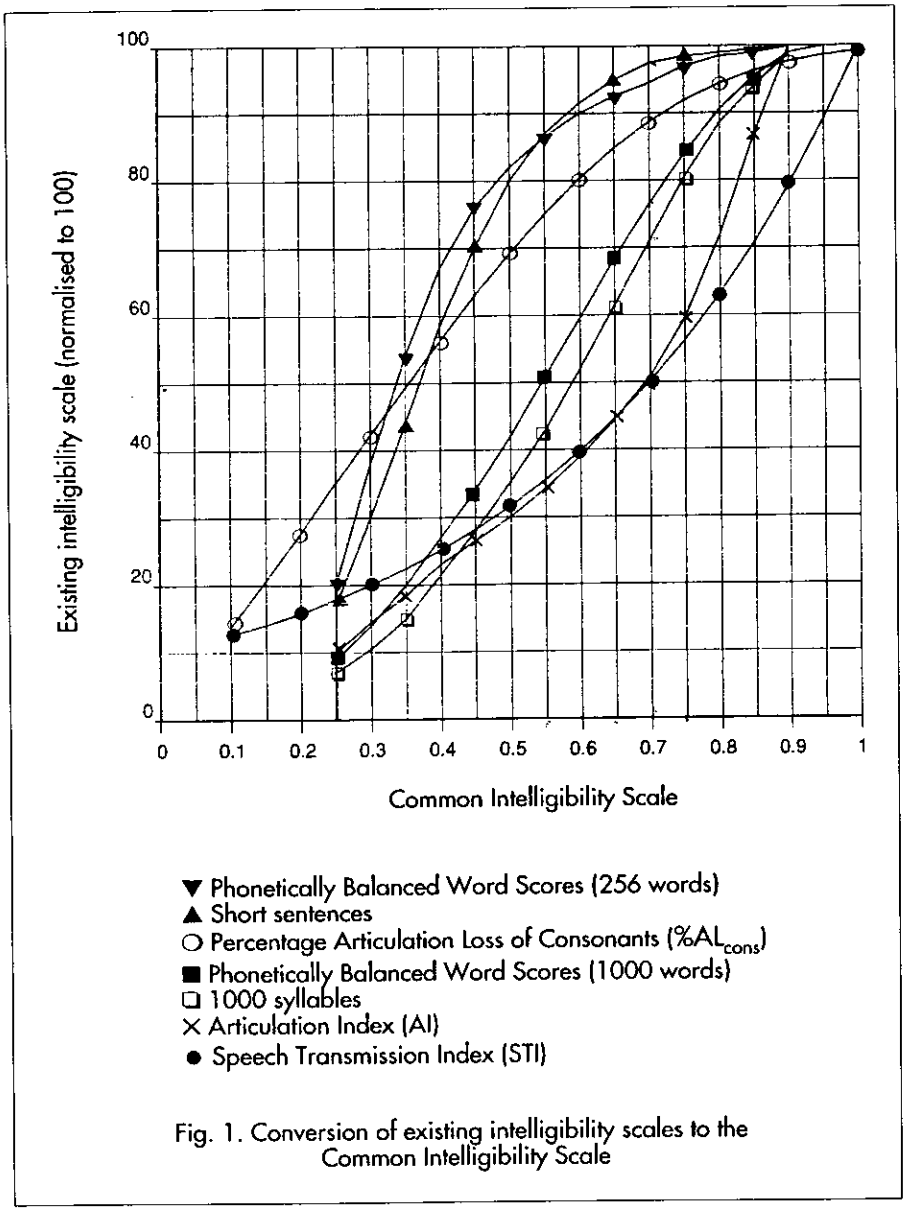

Fig. 1. Conversion of existing intelligibility scales to the Common Intelligibility Scale

The Results So Far

IEC849

The most significant development is the adoption in the draft of a new Common Intelligibility Scale (CIS), correlated with many other intelligibility scales, in which the requirement for intelligibility is specified. This allows the acoustician freedom to choose an appropriate method of determining the intelligibility, without specifying a series of values within the body of the standard.

The relationships between existing intelligibility scales and the CIS [Figure 1] are given in a normative Annex, which also details the way in which the method of determining intelligibility should be chosen, the status of the sound system during the measurements, the number of measurements to be made and how the raw data is to be processed, and the measurement of the sound pressure levels of the system and of the ambient noise.

The draft now requires the ambient noise level at the time of measurement to be stated with the results, and allows the system specification to exclude defined areas not likely to be occupied by people. This is as much as can properly be included in the standard: to be more definite about which areas are to be excluded is impossible, considering the diversity of building designs and the locations where there may be people who need to understand the messages.

In addition, an informative Annex is proposed, which gives details of several methods of measuring intelligibility, their limitations and the standards in which they are specified:

- (Full) Speech Transmission Index (STI). It is hoped to achieve some standardization of this method: existing computer-aided implementations differ in several significant ways, notably the weightings given to the various octave bands
- RASTI
- 'Phonetically-balanced' (properly 'phonemically-balanced') word scores
- Modified rhyme test
- Articulation index
- Articulation loss of consonants (%AL$_{cons}$).

One advantage of the CIS is that if any new methods of determining intelligibility are developed, once they are correlated with the CIS they can be used without any need to amend the standard.

IEC268-16

A complete proposal for the revised text has not been produced: it is not essential at this stage if enough text is produced to give the other countries a good idea of the work involved. The text which has been produced splits into three main parts.

(a) Limitations: A quantification of the limitations on the use of the RASTI method, based on the difference between the values

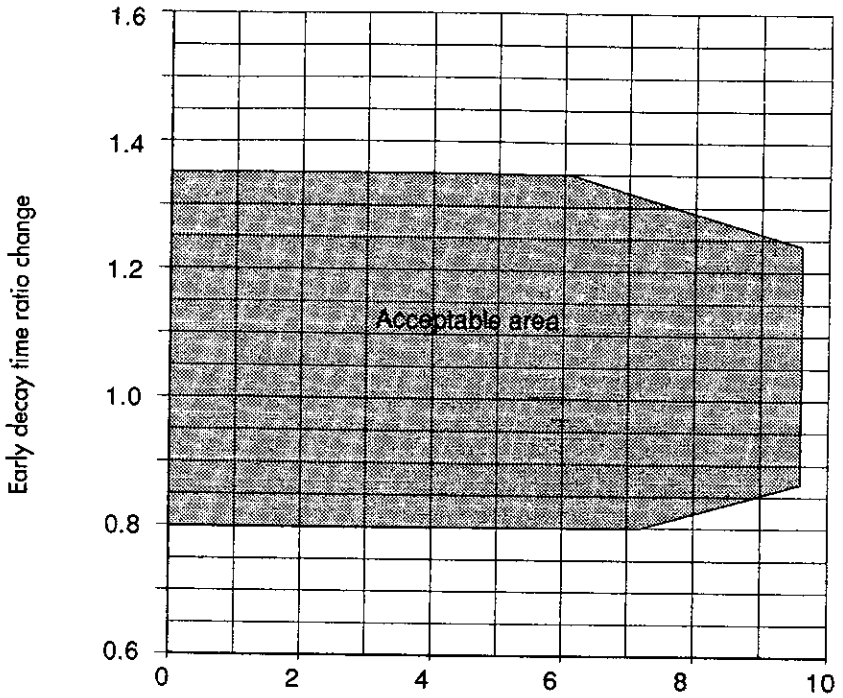

Fig. 2. Conditions under which the difference between RASTI and STI measurement results do not differ by more than 0.05.

measured by RASTI and full STI not differing by more than 0.05, which is considered to be the smallest significant increment in STI. The characteristics which are considered are the limits for non-linearity distortion, and uniformity of frequency response, octave-band early decay times and octave-band signal-to-noise ratios, these being inter-related (Figure 2), and the absence of acoustic anomalies, such as flutter echoes [3]. Although Figure 2 appears to deal only with signal-to-noise ratio and early decay times, the signal-to-noise ratio depends both on the noise spectrum and the frequency response. The 'acceptable area' in this figure is the area in which it is certain that the difference between RASTI and STI results is less than 0.05. Under some conditions, this criterion may also be satisfied at points outside the marked area, but this could only be discovered by carrying out both measurements, so a full STI measurement is required anyway!

Within the acceptable area, the effect of a difference of 5 dB in frequency response in any one octave band relative to the adjacent band(s) is to change the difference between the RASTI and STI results by an amount between 0 and 0.03. The higher differences occur with a flat noise spectrum and low early decay times. Reverberation dilutes the effects of non-uniformity in the frequency response and the noise spectrum.

The effect of non-linearity on the reliability of RASTI and STI measurements is obscure except in the case of peak clipping, which clearly tends to reduce the modulation depth of the received signal, and therefore the modulation transfer function. At present, it is considered that a 1 dB reduction in the r.m.s. value of a pink noise signal ('1 dB compression') due to peak clipping is a realistic limitation. Perhaps surprisingly, this represents approximately 17% total harmonic distortion of a sinusoidal signal of the same r.m.s. value as the noise signal. However, the value of 17% can be seen to be realistic when it is taken into account that systems using reflex horn loudspeakers can offer acceptable intelligibility.

(b) Measurement of STI using time-delay spectrometry equipment: This includes both direct electrical signal injection and acoustic injection. Methods of allowing for the effects of noise are detailed.

(c) Measurement of STI using maximum-length sequence analysis equipment: This addresses the same subjects as in (b) above. In both cases the method of acoustic injection to be used, when the microphone is not compatible with the usual form of artificial mouth, is detailed.

In addition, it is recommended to study the modulation reduction matrix itself, since much can be learned about the reliability of the results, or conversely, the source of any unreliability. It is possible that references to other methods of determining intelligibility may be included in this standard as well as in the revised IEC849.

Liaison With other Standards Committees

In Britain, this work has been done under the aegis of BSI committee EEL/32, but other committees are also concerned with speech intelligibility. On the 'user' side, FSM/12/1 deals with fire alarm systems, in which voice announcements are increasingly used. Representatives of this industry sector participated in the SCIF Panel work. In addition, BSI committee PSM/39 Applied ergonomics has a Panel PSM/39/-/3 on Danger signals and communication in noisy environments.

At the European level, CEN/TC122 parallels PSM/39/-/3, while at international level it is ISO/TC159/SC5. The main ISO committee concerned is ISO/TC43 Acoustics, which is paralleled by CEN/TC211 and BSI committee EPC/1. Steps have been taken to set up a liaison between EEL/32, PSM/39/-/3 and EPC/1. In order to ensure that the standards are correctly drafted and take all relevant matters into account, it is essential to establish liaisons between all concerned groups, which is best done by common membership: formal liaison through the Sec-

retariats is a slow and very inefficient process. It is thus vital that a sufficient number of experts are actively engaged in the work, because it is impossible for just a few to carry out all the tasks involved.

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Appendix 1

Draft Clause 6.1 of the UK proposal for the revision of IEC849 (BS7443), with new Annexes A, B and C.

6.1 Speech intelligibility

Unless otherwise specified, the following requirement shall be satisfied:

The speech intelligibility overall of an area of coverage (see 4.2) shall be greater than or equal to 0.65 on the Common Intelligibility Scale (CIS, see Annexes A and B). The ambient noise level (see B.5) at the time of measurement shall be stated with the test result.

The system specification may exclude from the area of coverage, defined areas not likely to be occupied by people.

Draft (new) Annex A (Informative) Measurement of speech intelligibility

A.1 Introduction

A number of methods of measuring speech intelligibility have been proposed, and several are mentioned in international and national standards. Work on this subject is continuing, notably in ISO TC43. Pending a completion of this work sufficient for the needs of this standard, this Annex briefly describes several methods which are available. It gives information on the correlations between them, and their limitations, either directly or by references to relevant standards. Annex B specifies the procedures to be used for the purposes of this standard.

It is recommended to choose, if possible, the method of measurement which gives the greatest discrimination in the range of intelligibility being investigated, as shown by the gradient of the relevant curve in Figure B1 being the steepest. For example, STI has the greatest discrimination at high values of intelligibility, while 256 word PB word scores has the greatest discrimination at low values.

A.2 Methods of measurement

A.2.1 Speech Transmission Index

The speech transmission index (STI) is derived by calculation from measurements of the modulation transfer function (MTF), and a number of computer-based measuring systems offer this facility. However, the details of the carriers and modulation frequencies to be used, and the weights given to them in the calculations, are not standardised.

A.2.2 Rapid Speech Transmission Index

The rapid speech transmission index (RASTI) results from a simplified method of determining the STI, using two octave-band noise carriers and four or five modulation frequencies. The method is described in IEC268-16.

A.2.3 Phonetically-balanced word scores

The phonetically-balanced (PB) word score method depends on the transmission of specially-chosen words, selected from a known population, to a panel of listeners. General information is given in ISO TR4870.

A.2.4 Modified Rhyme Test

The modified rhyme test (MRT) method also uses a panel of listeners.

A.2.5 Articulation Index

The articulation index (AI) is determined by measuring the sound pressure levels of the wanted speech signals and the ambient noise. It is described in Reference 1 (see Annex C, Bibilography)

A.2.6 Articulation loss of consonants

The articulation loss of consonants, usually expressed as a percentage with the symbol $\%AL_{cons}$, is determined from the results of transmission tests, using specially-chosen simple

words. It is described in Reference 2.

A.3 Limitations of the methods

A.3.1 General

All of the above methods can give misleading results unless the measurement procedure is carried out very carefully and in strict accordance with the relevant standard. Furthermore, it is essential that the ambient noise level at the time of measurement is very similar to that which occurs under normal operating conditions, unless an appropriate correction is made to the raw data of the test results.

Note: General information on intelligibility testing is given in ISO TR4870. See also B.4

A.3.2 Speech Transmission Index

The results are meaningful only if:

a) the system does not use any amplitude compression, expansion or non-stationary temporal processing.

Note – Such features may be provided in the system, but are by-passed for STI measurements. Their effect on intelligibility can be determined by other methods, such as phonetically-balanced word-scores (see A.3.4).

b) the total harmonic distortion of a sinusoidal signal giving the same sound presure level at the measuring position as the STI test signal does not exceed 17% (corresponding to approximately 1 dB of compression of a pink-noise signal due to peak clipping).

A.3.3 RApid Speech Transmission Index

The results are meaningful only if the requirements given in 4.3.3 of IEC268-16 are satisfied.

[Originator's Note: A NWIP to revise and improve IEC268-16 is being made.]

A.3.4 Phonetically Balanced word scores (256 population)

The limitations are given in ISO TR4870. It should be noted that, because the method is based on the reception of words by listeners, there are no limitations in respect of the characteristics of the sound system or those of the environment.

A.3.5 Modified Rhyme Test

The limitations are similar to those given in ISO TR4870. It should be noted that, because the method is based on the reception of words by listeners, there are no limitations in respect of the characteristics of the sound system or those of the environment.

A.3.6 Articulation Index

The limitations are given in Reference 1 (see Annex C).

A.3.7 Articulation loss of consonants

The limitations are similar to those given in ISO TR4870. It should be noted that, if the measurement procedure is based on the reception of words by listeners, there are no limitations in respect of the characteristics of the sound system or those of the environment. If, however, another method of measurement is used, there may be limitations in these respects.

A.4 Correlation of the results of the various methods

In order to specify a single figure for the intelligibility requirements of a system, and to compare results of different measurements, much work has been done to determine relationships between the results of the various methods of measurement. In most cases, these relationships are now firmly established and accepted, despite being subject to a degree of uncertainty or statistical variation. For the purposes of the present standard, it has been found necessary to correlate the results of each of the above methods to a new scale, termed the 'Common Intelligibility Scale' (CIS). An essential requirement, due to the above-mentioned uncertainty, is that the gradient of each correlation curve is neither too small or too great, as each of these conditions exaggerates the uncertainty in the correlation.

The correlations which have been determined are shown in Figure B.1.

[Note: Figure B.1 is identical to Figure 1 of the paper 'A new look at intelligibility in standards'.]

Annex B (normative)

B.1 Choice of method of measurement

The intelligibility shall be measured by one or more of the methods listed in Annex A, for which the requirements for reliable results are satisfied. The results shall then be converted to the CIS according to the relevant curve(s) given in Figure B.1.

B.2 Status of the sound system

Usually, the whole sound system should be in operation for all measurements. If measurements are carried out with the sound system in a special status, this shall be stated with the results.

B.3 Number of measurements and calculation of the result

The measurements shall be made at a sufficient number (n) of representative points, which shall be detailed in the system specification, in each area of coverage. The arithmetical average I_{av} of the intelligibility values on the CIS, and the standard deviation (s) of the results, shall be calculated. The quantity $I_{av} - s$ shall exceed the limit value specified in 6.1.

If the result is within ±s of the limit, the measurements should be repeated, preferably at a larger number of points.

Note – The mean value of intelligibility, and its 95% confidence interval, over the whole area of coverage should be calculated, taking into account the shape of the statistical distribution of the results of the measurements.

B.4 Sound pressure level

The C-weighted sound pressure level for the measurement shall be equal to the L_{Ceq}, measured for not less than 16 s at the measuring point when the system is in normal operation as an emergency sound system.

Note: If the RASTI method is used, A-weighting may be used for both measurements instead of C-weighting.

B.5 Ambient noise level

The A-weighted ambient noise level shall be measured in decibels.

Annex C (Informative) Bibliography

1. USA national standard ANSI S 3.5 (1969), American National Standards Institute, New York, USA.

2. V M A PEUTZ, 'Articulation loss of consonants as a criterion for speech transmission in a room', JAudEngSoc, 19, 12, (Dec 1971)

3. P W BARNETT & R D KNIGHT, 'Some practical limitations of STI method', ProcIOA, 14, 5, (1992)

Appendix 2

Draft proposal for the revision of IEC268-16 (BS6840-16)

1. Revision of the existing text

Part of the proposal for the revision of IEC268-16 is to quantify some of the conditions in 4.3.3 for the validity of the RASTI method, and to add further conditions, based on the principle that the difference between the RASTI and full STI results, and the error due to background noise, should each not exceed 0.05:

a) the system does not use any amplitude compression or expansion, and the total harmonic distortion of a sinusoidal signal giving the same sound pressure level at the measuring position as the RASTI test signal does not exceed

17%.
b) the uniformity of the overall system frequency response between the octave bands centred on 125 Hz and 6 kHz is such that the difference in sound pressure level between any two adjacent octave bands is less than 5 dB.
c) The uniformities, over the range of centre frequencies 125 Hz to 8 kHz, of the octave-band early decay times and signal-to-noise ratios fall within the permitted area shown in Figure 1.
(Note: Figure 1 is identical to Figure 2 of the paper 'A new look at intelligibility in standards'.)
This graph is plotted in terms of the following quantities:
i) the aggregate deviation of the signal-to-noise ratio, which is the algebraic sum of the differences of the octave-band signal-to-noise ratios from their arithmetic mean.
Signal-to-noise ratios which exceed ±15 dB are taken as ±15 dB respectively.
ii) the early decay time average ratio change, which is the average over the octave bands centred on 125 Hz, 250 Hz, 1 kHz, 4 kHz and 8 kHz bands, divided by the average over the 500 Hz and 2 kHz octave bands.
d) the acoustic environment is substantially free of discrete echoes, notably flutter echoes whose repetition frequency is an integral multiple of one or more of the modulation frequencies (see Reference 2).
It is necessary for all of the above conditions to be satisfied simultaneously.

2. Additional text on the standardisation of intelligibility tests using time-delay spectrometry equipment

2.1 General
Any compression or non-linear amplitude or non-stationary frequency or temporal processing shall be bypassed before carrying out STI or RASTI measurements, but it is essential to ensure that any consequent effect on the sound pressure levels produced by the system under test are compensated.
2.2 Method of measurement using an acoustic excitation signal
1. Set the artificial mouth, or a suitable test loudspeaker, at the normal speaking distance from the appropriate microphone.
2. Set the test signal level at the microphone to equal that of speech under normal operating conditions.
Note – A value of 67 dB (re 20 μPa) at 500 mm from the source in the octave band centred on 500 Hz is often used.
3. Check that the test signal spectrum is correct within ±1 dB over the range 88 Hz to 11.3 kHz (the limits of the 125 Hz and 8 kHz octave bands). Adjust the equalization (if any) of the artificial mouth or test loudspeaker, if necessary to satisfy this requirement.
4. Run the STI or RASTI test sequence. Normally, the 'with noise' option should be selected.
2.3 Method of measurement using direct (electrical) injection of the test signal
1. Follow the above procedure, replacing step 2 by step 2 below, selecting the injection point for the signal as close to the normal microphone input as possible, so as to include as much of the system as possible in the test.
2. Set the test signal level so that in the octave band centred on 500 Hz, the normal C-weighted operating sound pressure level of the system is produced.
Note – For RASTI measurements, the A-weighted sound pressure level may be used as reference.
2.4 Simulation of occupancy noise
The effect of occupancy noise can be determined by manually inputting noise data into the noise data table used by the measuring equipment or by mixing an artificial or recorded noise signal of the correct spectral content and level with the main signal input to the analyser.

3. Intelligibility tests using maximum-length sequence analysis equipment

3.1 General
The requirements given in 2.1 apply also to this method.
3.2 Configuration
Measurements may be made using direct (cabled) injection and recovery of the test signals and the system response (from the test microphone), or by making digital recordings of the test signals and the system response (from the test microphone) for post-processing. If the system input is via a microphone, the test signal shall be applied from an artificial mouth (see CCITT Recommendation P.51), unless the design of the microphone makes this physically impracticable, in which case a suitable transducer, such as a small, single-source high quality loudspeaker (cone diameter not exceeding 100 mm), shall be used, and described with the results.
The test equipment shall be set up to provide a sample length of at least 1 s, and the speech-shaped filter shall be used. For a full STI test, the 1 dB bandwidths of the test signal (prior to the speech-shaped filter) and of the receiving section shall both be at least 88 Hz to 11.3 kHz.
Specific types of measuring equipment may require the imposition of other special measuring conditions. Averaging and ripple reduction techniques are not appropriate for this measurement.
3.3 Simulation of occupancy noise
This may be accomplished as follows:
a) if direct (cabled) recovery of the system response is used, noise of the same spectral distribution as the expected occupancy noise shall be mixed with the recovered signal at the correct level to give the expected signal-to-noise ratio (see Note).
b) if digital recording of the system response is used, noise of the same spectral distribution as the expected occupancy noise shall be mixed with the recorded signal, prior to post-processing, at the correct level to give the expected signal to noise ratio (see Note).
Note – Due to the way in which the equipment performs its computations, it is necessary to set the noise level 3 dB higher than the level deduced from the expected signal-to-noise ratio.
3.4 Repetition of measurements
The measurements shall be repeated several times and the results averaged.
3.5 Analysis and interpretation of the results
It is important to examine the modulation reduction matrix to determine the reliability of the results.
As a rule, the values in each octave-band column should decrease with increasing modulation frequency. Constant or slightly reducing values in a column indicate the presence of noise. Large reductions indicate that reverberation is the main effect. Values which first reduce and then increase with modulation frequency indicate the presence of periodic or strong reflections, which may produce an over-optimistic conclusion. It is recommended that if this effect is detected, it should be reported with the results and an estimated correction applied.
For reverberation times exceeding 4 s, care should be taken to avoid aliasing effects.

4. Additional text and references to other methods of determining intelligibility

(PB word scores, Modified Rhyme Test, Articulation Index, Articulation Loss of Consonants and any other proposals)
(Under consideration. Although purely acoustic methods are a matter for ISO/TC43, brief references here could be very helpful.)
Annex (Informative)
Bibliography and reference
1 T HOUTGAST & H J M STEENEKEN, Brüel & Kjær Technical Review, 3, 1985, Copenhagen, Denmark
2 P W BARNETT & R D KNIGHT, 'Some practical limitations of STI method', ProcIOA, 14, 5, (1992)

Appendix 3

BS 7443 Workshop on Speech Intelligibility

During 1992 – 93 the Institute convened a Working Party to consider the speech intelligibility aspect of BS 7443: Sound Systems for Emergency Purposes. This group, which comprises Peter Barnett (chairman), Martin Armstrong, Paul Doany, Dr Ian Flindell, Rob Harris, Peter Mapp, Philip Pratt, Ken Walker, John Woodgate and Neil Woodger, produced the concept of a 'Common Intelligibility Scale' (CIS). The idea is that the scale, which is shown in Figure 1 of John Woodgate's paper to which this note is appended, could be approached from a number of different methods. The finishing touches to the scale were produced during the summer of 1993 and a workshop discussion was convened at the IOA's Reproduced Sound 9 Conference, the details of which are reported elsewhere in this issue, to discuss and debate areas of concern or contention.

The meeting lasted around one hour and a number of issues were raised and debated. Generally the scale was well received but a number of reservations were expressed.

Firstly it was acknowledged that, depending upon the actual degree of intelligibility range, each method offered varying degrees of sensitivity and hence it would be possible to select a method which would give the most optimistic results under the prevailing conditions. It was, however, pointed out that from a contractual point of view the specifier is not precluded from specifying both the CIS target value and the method of measurement. There was also concern that given that we had mostly become familiar with RASTI then why consider other measures which will only serve to complicate the matter. Although there was some support for this premise it was generally felt that extending the measurement methods was a step in the right direction. Perhaps one of the most vexing questions regarded the selection of a method which may favour one particular acoustic climate rather than another. Of all the questions posed this probably received the most attention but without a definitive conclusion. Finally, there was concern that the correlation between measurement methods may not be constant for varying acoustical conditions. Again, much debate – no conclusions.

All in all it was useful discussion and on behalf of the Working Party members I would like to thank those who attended the discussion which was well attended given the late hour. Finally, the Working Party are all aware that the proposal for a Common Intelligibility Scale is radical and cutting-edge stuff. It does seem however, a good idea. If you have any comments on John Woodgate's paper the Working Party would welcome them.

Peter Barnett MIOA

John M Woodgate is Principal of J M Woodgate & Associates, Electronics Design, Standards & Marketing Consultants, 3 Bramfield Road East, Rayleigh ❖

REPRODUCED SOUND 9

28 – 31 October 1993, Windermere

Introduction

The ninth conference was one of the most successful of the series having attracted a delegate count of one hundred and thirty-seven from the wide spectrum of professionals, around sixty percent of whom were members of other institutions, engaged in the subject.

The conference was organised with the collaboration of the Sound and Communication Industries Federation, the Audio Engineering Society, the Association of Professional Recording Services, the Association of British Theatre Technicians and, for the first time this year, the International Association of Forensic Phonetics.

The technical programme was assembled by an inter-association committee, chaired by Ken Dibble MIOA of Ken Dibble Acoustics, comprising James Angus FIOA of the University of York, Peter Barnett MIOA of AMS Acoustics, Guy Hawley from Harman Audio, Allen Mornington-West of Quad, Andy Munro of Andy Munro Associates, David Trevor-Jones MIOA now of Fleming and Barron and Tony Woolf from the BBC.

On offer at various times during the weekend was a range of interesting topics under the headings of Speech Intelligibility, Loudspeaker Development, Environmental Effects, Broadcast Sound, Home Cinema Surround Sound, Forensic Acoustics and an Open Session. An important event was the Workshop Discussion on Proposed Revisions to BS 7443, the deliberations at which are summarised in this issue under the heading of Standards, whilst a panel discussion on Home Cinema and Surround Sound Audio enlightened the audience on the pros and cons of the latest in audio/visual experiences.

A new feature of this year's conference was the training course in Acoustics for Sound System Engineers which was run in parallel with the main sessions.

The Hydro Hotel maintained its high standard of comfort and catering and the beauty of the surrounding countryside wove its usual spell in making this event unique in the Institute's calendar.

Thursday evening, before the start of the conference proper on Friday morning, was enlivened by a lecture on a serious subject given in an approachable and enthusiastic manner by David Bull of Colchester Institute. His subject was noise induced hearing loss, the causes, consequences and the means of hearing protection. The lecture was well illustrated by slides, overheads and aural demonstrations some of which might well have been promoted by the percussion section of the local orchestra!

On Friday evening after dinner a very impressive Presentation and Demonstration of the Super–Dual Loudspeaker was given by Tannoy UK Ltd. After the recordings of pop and classical music the reproduction of the sounds of a machine gun and the main gun of the Challenger battle tank sent most people scurrying for cover!

This was followed by a more peaceful Panel Discussion on Home Cinema and Surround Sound. This discussion took place at 10pm and the fact that an audience of some 40 people were present at this late hour was an indication of the interest in this novel form of entertainment.

On Saturday evening, courtesy of Harman Audio UK Ltd, there was a film show (including a showing of 'Hook') in surround sound home cinema format.

Reports on the technical sessions follow based mainly on the reports of the session chairmen.

Speech Intelligibility

Chairman: M Plato (London Underground Ltd)

The first speaker, Mr Tony Worth concluded that, following some six to nine months of extensive research into public address, its uses and whether in fact it is needed at all, LUL has concluded that it was very important to their business. The top reason given was that it gave all important comfort, which was a surprise, as well as giving them information which was the more expected answer.

Peter Barnett of AMS Acoustics introduced the concept of binaural recording and showed, following extensive tests at Aldwych Underground Station, that it very accurately mimicked actual hearing conditions on site (more accurately than either mono or stereo recording techniques). When used, as in this case, to conduct PB Wordscore tests, the use of binaural recording successfully controlled other influences such as fatigue and boredom which can adversely affect the results.

Following Peter Barnett's research, Richard Knight showed that the full STI produced a very similar result to PB Wordscores, both confirmed expected results and fell tolerably well on a best fit intelligibility line. RASTI on the other hand was shown to produce optimistic readings when background noise was present and overly pessimistic readings when used in areas with a high level of reverberation.

Finally Neil Woodger of Arup Acoustics presented a proposed standard for a loudspeaker and its installation on London Underground platforms (ie a speaker with 160° horizontal and 80° vertical coverage installed 2.5 m above platform, 4 m apart). He also proposed a number of alternative speakers that could be tried and tested to confirm calculations, these would now hopefully be put into practice by LUL.

Loudspeakers

Chairman: Dr J A S Angus (University of York)

The session began with a provocative invited keynote paper by W Woodman of Loudspeaker Technology Ltd in which he suggested that the UK loudspeaker industry needed to get back to basics, in an engineering sense, if it wanted to

hold on to the technological lead that it had in the preceding decades. He then went on to review the requirements for a high quality loudspeaker which, he suggested, were achievable through the use of good engineering.

The session had three papers contributed by speakers from Tannoy Ltd; K Rogerson and A Garner discussed aspects of Digital Sound Processing (DSP) systems applied to loudspeaker design. Rogerson discussed the technical requirements of such a system and presented the results of a Tannoy design. Garner concentrated on what such systems can and cannot do and suggested a possible standard. The third paper, given by P Mills, discussed the advantages of current drive to a subwoofer loudspeaker system and gave results of an experimental system which showed reduced distortion compared with a voltage driven system.

K Holland from ISVR presented an interesting technique for measuring loudspeakers based on the use of cepstral processing. He reviewed the cepstrum as a technique for removing echoes (reflections from the measurement environment) and presented some results which showed that the method may have some utility in enabling 'free field' measurements in non-anechoic environments.

In a change of perspective Ben Duncan of Ben Duncan Research discussed the problems of designing very high power (4kW) amplifiers for live PA applications. He dealt with the pro's and con's of various output stage topologies and described some of the practical problems of such a system. These included current handling in the loudspeaker connections and electrical safety due to the high voltages present.

The session was brought to a close by S Carrington of SPC Design who presented an unusual and novel loudspeaker diaphragm design based on a coiled tube structure. His demonstration of the loudspeaker with a variety of musical examples brought an interesting and diverse session to a close.

Alex Munro, Managing Director of Tannoy, introducing his company's demonstration of their new Super-Dual loudspeakers

Environmental Effects

Chairman: D Trevor-Jones (Fleming & Barron)

Following last year's thorough review, only two papers providing updates on topical issues were presented this year. J Staunton described the contrasting community reactions to the two series of concerts held over the summer at Wembley Stadium which he, J E T Griffiths and S S Kamath had related to frequency analyses of the fugitive sound. Evidence for the correlation of annoyance with the low frequency sound component seemed clear and as a result the authors proposed the extension of environmental noise guidelines to incorporate explicit low frequency limits. Much of the ensuing discussion, as lively in the bar as in the session, centred on the use to which such limits might be put.

D Trevor-Jones presented a brief overview of the development of the Noise Council's Environmental Noise Guidelines for pop concerts and described the present Draft. Although the latter was widely circulated for public comment in July the response from the entertainments industry has been very poor indeed.

A further month remained for comment and those present with an interest were encouraged to contribute.

Broadcast Sound

Chairman: A R Woolf (BBC)

In this session A R Woolf of the BBC started by outlining some of the problems encountered in implementing the legislation on noise at work in a broadcasting organisation. D Kirby of the BBC Research Department then explained why such an apparently basic thing as keeping television sound in step with the picture so often goes wrong, and explained a simple but ingenious way of improving matters. Other broadcasters will surely watch the BBC's field trials with interest.

Journalist T Frost gave a useful overview of the bit-rate and channel options in MPEG systems. C Grewin, Swedish Radio's Head of R and D, described the subjective testing of low bit-rate audio codecs which Swedish Radio undertook on behalf of the MPEG Audio Group, and concluded (perhaps against intuition) that they should best be introduced working from the transmitter backwards. He pointed out that the time spent in trials must be very short compared with the 30 or so years that the public, hopefully, will have to find defects in the system adopted.

D Errock, BBC, explained the House of Commons' new broadcast and sound reinforcement system, whose software control allows the

change of gain and delay to each of the 530 loudspeakers, for every microphone selected. K Dibble of Ken Dibble Acoustics described how the loudspeakers were chosen.

Home Cinema Surround Sound

Chairman: Allen Mornington-West (Quad Acoustics)

F J Ampel of Technology Visions, USA, gave an enthusiastic and profit-anticipating review of the prospects for this new form of entertainment, designed to recreate the theatrical experience at home. He estimated 95 million potential sales in the USA and 150 million worldwide for home cinema with surround sound. A Garner and K Rogerson of Tannoy Ltd then gave a presentation on the application of point source loudspeaker technology to surround sound audio tracks for home cinema. This was followed by D A Keating and M P Griffin of University of Reading discussing the problems of providing headphone listeners with a satisfactory image of spaciousness when listening to stereo and surround recordings. This interesting and prophetic session ended with D Fraser of Dolby Laboratories UK Ltd discussing encoding and decoding systems for home cinema surround sources.

Forensic Acoustics

Chairman: Dr P French (Peter French Associates)

A session was mounted on Sunday morning on Forensic Applications of Phonetics by six members of the International Association for Forensic Phonetics. An overview of forensic phonetics was presented by P French, who is a private consultant, followed by papers from other members on a range of more specific issues.

A theme addressed by two contributors (A Hirson of City University, London and Elizabeth McClelland, an independent forensic consultant from Edinburgh) was that of determining the content of poor quality or otherwise difficult recordings.

The uses of sound spectography in this task were illustrated by material arising from actual forensic cases. M Duckworth, from Cardiff Institute of Higher Education, and A Hirson addressed the question of establishing phonetic invariants in cases of speaker identification where one is attempting to compare a disguised voice with a non-disguised sample from a suspect. D Howard from York University, A Hirson, P French and J E Szymanski, also from York University, presented the results of an experimental study of the comparative reliability of commercially-available software packages for estimating voice fundamental frequency. The session concluded with the panel of contributors taking questions from the floor.

Open Session

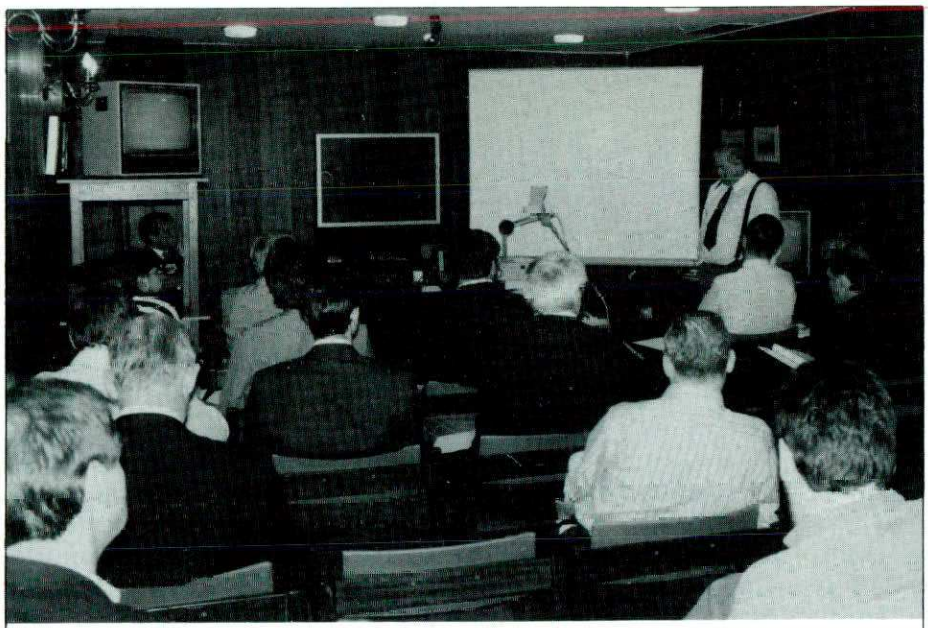
Chairman: Dr R Lawrence (Oscar Faber & IOA)

There were four papers in this final session which were not as disparate as the title usually implies. The first concerned the effect of acoustic diffusers on room modes and was given by J Angus of York University. This dealt with the problems of achieving the desired diffuse reverberant sound field in studios, concert halls, control and dubbing rooms.

O Kirkeby of ISVR followed with a description of a method of processing a recorded incident sound field to extract direction of-arrival information by reconstructing the wavefront using a matrix of linear filters. The matrix operates on the vector of the recorded signals to produce a vector of signals which are then fed to an array of loudspeakers to reproduce the original sound field together with direction-of-arrival information in a restricted listening space. The technique showed some promise of success in preliminary computer simulations and in a simple experiment.

In the third paper J Angus took the floor again to explain the advantages and disadvantages of directly processing a one bit audio signal, using a second order filter section, compared to the traditional multibit system. It was shown that many component savings could be made at the price of faster clocking hardware and marginally higher coefficient wordlengths. It was suggested that the magnitude response of the filter could be as good as that of multibit systems and that the phase response was an improvement on systems that clock at the Nyquist rate.

F Orduna-Bustamante of ISVR wound up this session, and the whole conference, by presenting a strategy on sparsely updated filters for the adaptive digital processing of audio signals. This allows the implementation of adaptive filters at high sampling rates using existing DSP technology. The paper presented



The training course, 'Acoustics for Sound System Engineers', in progress

code for both the LMS and the filtered-x LMS algorithms and demonstrated their practical use for loudspeaker equalisation.

Panel Discussion

Home Cinema and Surround Sound Audio

An audience of more than forty were present during this discussion session which commenced at 10pm on the Friday evening. The discussion was led by A Mornington-West supported by a panel comprising A Garner of Tannoy, F Ampel of Technology Visions, S Spears of Harman International, A Jones of KEF, T Frost who is a consultant, A Benham from Home Entertainment Magazine and D Fraser of Dolby Laboratories. The purpose of the session was to offer an opportunity to exchange information, experience and views regarding a wide range of technological, economic and socio-economic factors underlying present developments. There was general agreement that whether the amount individually invested in the technology is as low as £800 or as high as £20,000 or more, the purchaser is seeking a special kind of combined audio and video experience in his or her home and the technology must manifestly evolve in the direction that will most satisfactorily achieve this. It appears that loudspeaker placement is less critical than for conventional stereo audio in order to create an involving sound. It is therefore perfectly valid to consider using the audio installation for the audiophile experience with or without the involvement of the picture signal.

It was generally agreed that standards will have to be treated with great care, particularly because the public, whose memory was said to be only just recovering from the so-called 'distasteful experience' of the quadraphonic saga, may feel very short-changed if they are exposed to imported equipment of poor technical quality.

There was no major disagreement with the assertion that Europe is two years or so behind the United States in terms of the total development of the whole home cinema market and there was a general feeling that European engineers and designers should take careful note of this sea change in consumer leisure spending or accept that they would be condemning their respective companies to satisfying the aesthetic demands of a dwindling band of audiophiles.

Training Course

'Acoustics for Sound System Engineers'

This was an intensive course occupying Friday afternoon and Saturday morning, sessions chosen to optimise time utilisation from the point of view of the time delegates spent away from their employment. The idea for this course arose from a belief that an inadequate appreciation of the behaviour of sound in enclosed spaces may be restricting the quality of work carried out by some sound system engineers.

In the event 27 delegates participated. The course was held in the Teak Room and all delegates were given a certificate to indicate they had attended. Delegates received a hard copy of the text of the course, the intention being that those who did not follow the discussions completely first time would have a reference work to return to.

The tutors for the course were Dr R Lawrence, who is chairman of the Institute's Education Committee, Peter Barnett of AMS Acoustics, David Trevor-Jones, now of Fleming and Baron, Dr Paul Darlington from the University of Salford and John Woodgate who is a consultant on standards.

Roy Lawrence took the major part of the course and led delegates from the simple one-degree of freedom mechanical or electrical oscillator to the idea of three-dimensional boundary conditions and modal behaviour in an enclosed space. The point was frequently made during this part that the value of assimilating, and correctly using, the proper language of acoustics is something that all professional acousticians become aware of during their development and that the use of the correct language is an important step in developing precise ideas.

David Trevor-Jones elucidated, with taped examples, interesting facets of human hearing, many of which bear on issues that arise on a daily basis to those involved in reproducing sound. He also discussed legal and technical aspects of the control of nuisance and hearing damage as applied to sound reproduction. Paul Darlington carried the ideas of diffraction set down earlier to discuss the nature and origins of wave-related phenomena exhibited by microphones and loudspeakers.

Peter Barnett extended the wave physical picture of sound in an enclosure to the higher frequency regime by introducing the implications, such as reverberation, of the statistical approach. The last two parts brought the discussion firmly into the province of the day to day concerns of the delegates.

John Woodgate completed the proceedings with a discussion of standards.

It was clear that care must be taken in the fullness of time to digest the lessons of the exercise. The immediate impression gained was that there is a need for this type of course.

Delegates arrived with very different backgrounds: at one end there was a delegate with a good honours degree in physics and many years' experience in high-level consultancy; at the other end there were some with considerably less by way of formal training. It was not surprising perhaps that early reactions indicated that some derived significantly more benefit than others. It was also clear that the prepared material for the course was excessive for the time available.

There did seem to be some evidence that delegates benefited from being part of the conference as a whole.

The direction of any further involvement of the Institute in collaboration with colleagues at the Sound and Communication Industries Federation – and any others that may feel inclined to participate – is an issue that will receive consideration in the near future. ❖

CALLS FOR PAPERS

Noise Nuisance and the Law

(Organised by the London Branch and the Environmental Noise Group)

Church House Conference Centre, London
Wednesday 18 May 1994

Noise control is inextricably linked with the law. Many feel that the law is not tough enough in this area, others feel that too much fuss is made and welcome the UK Government's move to de-regulation. This one-day meeting provides an opportunity to discuss the issues.

Papers are invited in any of the following topic areas:

• The use and effectiveness of the Environmental Protection Act 1990 • The use and effectiveness of the Control of Pollution Act • The implications of the Noise and Statutory Nuisance Act 1993 • Areas where the law on noise control appears deficient • Areas where the law on noise control appears too onerous • Presenting expert evidence on noise • Legal/Technical Criteria •

Anyone offering a paper for this meeting, which if accepted will be published in Volume 16 of the Proceedings of the Institute of Acoustics (1994), should send a 100 word abstract to the meeting organisers by 15 March 1994.

Meeting Organisers: P T Freeborn, FIOA & S W Turner, MIOA TBV Science, The Lansdowne Building, Lansdowne Road, Croydon, CR0 2BX Tel: 081 401 5800 Fax: 081 401 5862

10th Annual Week-end Conference

Reproduced Sound 10

(Organised in collaboration with AES, APRS, ABTT, the International Institute for Forensic Acoustics and SCIF)

Windermere Hydro Hotel
3–6 November 1994

At present it is intended that the formula will be similar to that of Reproduced Sound 9. Invited and contributed technical papers, workshops, discussion sessions, seminars, commercial presentations. It is also intended to offer a repeat of the training course entitled 'Acoustics for Sound System Engineers' that was run for the first time in 1993. There will also be a manufacturers exhibition and the traditional social and accompanying persons programmes.

Offers of contributions on any aspect of the art and technology of reproduced sound should be sent in the form of a short abstract, indicating whether it is intended that the paper will be offered for the new refereeing procedure, to:

The Programme Committee Chairman, Ken Dibble CEng MIOA, Ken Dibble Acoustics, Old Rectory House, 79 Clifton Road, Rugby, Warks CV21 3QG. Tel 0788 541133, Fax 0788 541314.

INSTITUTE DIARY 1994

10 FEB
IOA Education Committee
St Albans

11 FEB
IOA CofC in Workplace Noise Assessment, exam
Accredited Centres

16 FEB
London Branch mtg: Visit to the Royal Academy of Music
London

16 FEB
Eastern Branch mtg: Noise from Windfarm Developments
Woodbridge

17 FEB
Windfarm Noise Mtg
London

24 FEB
IOA Medals & Awards, Publications, Council
St Albans

1 MARCH
North West Branch mtg and AGM

4 MARCH
IOA CofC in Env Noise M'ment exam
Accredited Centres

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

16 MARCH
London Branch mtg: Helicopter Noise:
London

23 MARCH
Eastern Branch mtg: Ground Borne Vibration
Braintree

25 MARCH
IOA CofC in Environmental Noise M'ment Advisory Committee
St Albans

30 MARCH
IOA Diploma Exam Board
St Albans

18 APRIL
ACOUSTICS '94, 4 days
University of Salford

20 APRIL
Institute AGM
University of Salford

27 APRIL
London Branch mtg: Noise Incidence Survey of England and Wales.
St Albans

30 APRIL
Eastern Branch Dinner
Woodbridge

12 MAY
IOA Membership, Meetings and Education Committees
St Albans

18 MAY
London Branch mtg, Noise Nuisance and the Law
London

20 MAY
IOA CofC in Workplace Noise Assessment exam
Accredited Centres

25 MAY
Eastern Branch mtg: Overview of Low Frequency Environmental Noise Survey
Colchester

26 MAY
IOA Medals & Awards, Publications, Council
St Albans

10 JUNE
IOA CofC in Env Noise M'ment exam
Accredited Centres

16 JUNE
IOA Diploma exams, 2 days

22 JUNE
London Branch mtg: Outdoor Sound Propagation
NESCOT, Ewell

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

8 JULY
IOA CofC in Environmental Noise Mm'nt Advisory Committee
St Albans

28 SEP
Eastern Branch mtg: Acoustic Design of Broadcasting Studios
Cambridge

29 SEP
IOA Membership & Meetings Committees
St Albans

6 OCT
IOA Medals & Awards, Publications, Council
St Albans

14 OCT
IOA CofC in Workplace Noise Assessment exam
Accredited Centres

26 OCT
Eastern Branch mtg: Sound Quality
Norwich

3 NOV
Reproduced Sound 10, 4 days
Windermere

4 NOV
IOA CofC in Env Noise M'ment exam
Accredited Centres

10 NOV
IOA Education Committee
St Albans

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

24 NOV
1994 Autumn Conference
Speech & Hearing, 4 days
Windermere

1 DEC
IOA Membership & Meetings Committees
St Albans

2 DEC
IOA CofC in Environmental Noise Mm'nt Advisory Committee
St Albans

8 DEC
IOA Medals & Awards, Publications, Council
St Albans

1994 Spring Conference

Acoustics '94

University of Salford

18–21 April 1994

Late papers still being accepted

Fax the Institute Office on
0727 850553

CALLS FOR PAPERS

1994 Autumn Conference

SPEECH AND HEARING

(Organised by the Speech Group)

Windermere Hydro Hotel

24–27 November 1994

Offers of contributed papers are invited on all related topics, including:

- Speech Analysis
- Speech Production
- Speech Perception
- Auditory Modelling
- Speech Recognition
- Speech Synthesis
- Speech Corpora
- Speech Aids for the Handicapped

Intending authors are requested to submit a 200 word abstract to the Technical Committee Programme Chairman by 1 March 1994. Authors of accepted abstracts will be invited to send papers, should they so wish, for refereeing by 1 May. All accepted papers will be presented in oral or poster sessions and published in Volume 16 of the Proceedings of the Institute of Acoustics (1994) which will be available to delegates at registration.

Technical Programme Committee Chairman:
Professor W A Ainsworth FIOA,
Department of Communication and Neuroscience,
Keele University, Keele,
Staffordshire ST5 SBG.

SPEECH GROUP

One Day Meeting on

Large Vocabulary Speech Recognition

followed by the Group AGM

Cambridge University Engineering Department

Thursday 17 March 1994

Large vocabulary speech recognition systems have matured considerably since the last one day meeting held on this topic in March 1992 and it is therefore timely to meet again to review progress and identify new areas of research. Papers are therefore sought from all areas relevant to large vocabulary recognition including acoustic modelling, speaker adaptation, language models, decoder design and real time implementation.

As previously, there will be an opportunity during the lunch hour to demonstrate working recognisers including both research systems and commercial products.

Prospective speakers should send a short abstract of their talk to Steve Young, Engineering Dept, Trumpington Street, Cambridge, CB2 1PZ (sjy@eng.cam.ac.uk) no later than Friday 18 February 1994.
Anybody wishing to give a demonstration should also make contact by this date.

MEMBERSHIP

The following were elected at the Council Meeting held on 9 December 1993

Member
Beckett, C
Breslin, M
Brierley, T
Cheng, K W
Chu, T L
Clarke, T
Collman, R A
Cox, S J
Currie, J A N
Dhillon, M S
Dilworth, C W
Donnelly, J
Hallett, T M
Hardie, D J W
Lam, M K
Ledger, D N
Long, S C
Meng, Z
Murfitt, J P
Negishi, H
Owen, R G
Parkinson, R K
Prince, J M
Robins, A R
Swift, C G
Thompson, I M
Thompson, I M
Walsh, S J

Associate Member
Anakwue, P M
Cheung, C K A
Chou, K H D
Farr, R W
Figgins, W
Gillan, F S
Hopkins, A D
Hunte, O D
Kam, J K
Kelly, R O
Mart, N A
Renton, S G
Shingler, H
Voce, N R
Walmsley, A
Watson, J M

Associate
Fritsch, H B
Mok, K M H
South, T M
Walker, H G

Student
Adam, R
Norton, A R A

Certificate of Competence in Workplace Noise Assessment

The following were successful in the 14th examination held in October 1993

Colchester
Gray, G
Pascoe, N L
Pike, D J
Simpson, B M W
Wild, J

NESCOT
Daines, T M
Eddiford, R P
Leeworthy, C
Moloney, B
Schofield, N
Thompson, R
Watts, D L

Liverpool
Bryan, M
Jackson, R
Royle, A F
Ten-Wolde, R

Newcastle
Andreetti, F
Gourlay, G
Wilson, D

Bristol
Burgess, M J
Bushen, P
Davies, M
Hetherton, R B
Jones, S M
Long, G R
Newhams, G

Salford
Fone, C

South Bank
Belton, G
Goring, P
Lyons, J
Maslin, A
Reeve, C

Staffordshire
Bartmanis, N
Beardmore, J
Deakins, K
Patel, R
Perkins, A

Loughborough
Bailey, R A
Brinkworth, N G
Hutchings, S J
Roseblade, M P
Tipper, H

British Rail
McMillan, L

Certificate of Competence in Environmental Noise Measurement

The following were successful in the 2nd examination held in November 1993

Bristol
Freegard, J P
Hope, Y M
Seymour, D A

Colchester
Ballard, S
Chandler, P R
Gough, C L
Gough, K
Herbert, J A
Jowett, R D
King, A
O'brien, S N
Owen, C J
Thompsett, A C
Woods, S E

Derby
Taylor, N F
Tilley, P
Weekes, R J
Worth, H E

Liverpool
Bithell, D
Boland, F
Booth, G
Coulson, K G
Dobbyn, R A
Mcginnity, I D
Peel, S
Robinson, P
Shenton, A V
Simpson, P C

NESCOT
Atkinson, P G
Bowyer, L K
Bright, D J
Clements, B H
Colclough, J
Harney, K L
Minshull, R
Robertson, N K
White, A J
Wiles, R W
Williams, A J

South Bank
Dobbie, A
Maslin, A
Watson, R
Welch, R

Quieter Transport with Rubber

(Shock, Vibration and Noise Control for the Benefit of User and Environment)

Meeting organised by the Institute of Materials, co-sponsored by the Institute of Acoustics

University of the West of England, Bristol, 22 April 1994

Further information from the Institute office

1993 AUTUMN CONFERENCE – ENVIRONMENTAL NOISE

18 – 21 November 1993, Windermere

Introduction

This conference was the twentieth the Institute has held at the Hydro Hotel since 1979. With 180 delegates and exhibitors it was also the second largest in terms of numerical support. Delegates to previous conferences there may be interested to know that the usual type of intensive programme of technical sessions and workshop discussions was accommodated without resorting to parallel sessions. Delegates who could not be accommodated in the Hydro Hotel were placed in one of seven other hotels nearby.

The exhibition was very well supported by instrumentation and manufacturing companies; the innovation of accommodating it in the ballroom, which also houses one of the bars, proved widely popular. The exhibitors were Brüel & Kjær (UK), CEL Instruments, Cirrus Research, Diagnostic Instruments, Dynamic Engineering, Ecophon Pilkington, Gracey & Associates, Hakuto International, Industrial & Marine Acoustics, Kirby Charles Associates, A Proctor Developments, Quantitech, Sound Absorption and Transport Research Laboratory.

The reputation of the Windermere conferences as opportunities to meet and exchange views with others from the acoustics fraternity was maintained; the bars were packed with high decibel discussions on high decibels until after 4am each morning!

The Keynote Paper was presented by Dr Herbert Müller who is responsible for sound and vibration matters in the Urban Environment Division of the European Commission's Directorate General XI – Environment, Nuclear Safety and Civil Protection. In his paper, reproduced in this issue of the Bulletin, Dr Müller reflected on the future development of noise policy in the Commission. In particular he listed a number of 'actions' set out in the work plan for the 5th Environmental Action Programme. These included an inventory of exposure levels, further reductions of noise emission, measures related to infrastructure and physical planning (zoning) and standardisation of noise measurement and ratings. Dr Müller described the EC targets up to the year 2000 as ambitious and comments were made to the effect that this was particularly so in the standardisation area where, if the UK is taken as an example, there have been, and continue to be, considerable difficulties within one country, over harmonisation of noise measurement and rating methods for various sources of noise.

The technical programme was particularly well organised by Jeff Charles of Bickerdike Allen Partners with the assistance of Les Fothergill of BRE. There were thirty-five contributed papers and four workshop discussions; the whole programme knitted together in a way that took maximum benefit from the fact that the conference was a residential one.

The President-Elect, Mr Alex Burd presented a cheque for £250 to M Rickaby of the London Borough of Hillingdon, being the IOA prize for the best overall performance in the 1993 examinations for the Institute's Diploma in Acoustics and Noise Control. Reports on the various technical activities follow.

Prediction of Noise

Chairman, W Stubbs (Wimpey Environmental)

Proceedings commenced with a paper given by J P Seller from South Bank University on clay pigeon shooting noise. This gave a logical method of predicting noise levels, subject to tolerences for wind effects. P Hepworth described work on predicting noise from open cast coal sites, carried out for British Coal Opencast. I W K Ng gave a paper on road traffic noise in Hong Kong and M Legerton a comprehensive description of current work on wind turbine noise. B Hemsworth described the draft document, Calculation of Railway Noise. The last two papers of the morning session concerned ground vibration from railways and were presented by C Jones and V Krylov.

Response to Noise

Chairman, B F Berry (NPL)

C Grimwood, BRE, opened with a thought provoking account of the recent national survey of the effects of environmental noise on people at home. An interesting group discussion technique had been used, and from the experiences discussed, a simple three-level model of the noise reaction process was deduced. R Hawkes from W S Atkins Noise and Vibration gave an initial account of two on-going pilot studies on human response to industrial and transportation noise. The emphasis of the presentation was on the problems of elucidating the language and concerns of the general public with regard to noise from the two source types.

Denise Artis from the Department of Legal Studies at the University of Central Lancashire considered, in a very systematic way, the effectiveness of the various legal controls available to local authorities and individuals in seeking to prevent or abate a noise problem. She also highlighted recent and proposed legislative changes and posed the question 'Do they go far enough?' The paper provoked a lively discussion.

D Smeatham from the University of Salford reviewed some of the key research on annoyance due to noise from light aircraft and presented initial results from a survey of local authorities. J Seller illustrated some problems associated with obtaining an appropriate value of background noise level in terms of L_{A90}. In particular he raised the question of the influence of wind direction. There was a distinctly meteorological flavour to the ensuing discussion.

S O'Rourke from Cirrus Research concluded the session with a very comprehensive review of the concept of short term L_{eq}. His presentation included a notably honest account of various nocturnal practices indulged in by a French colleague in 1986 in an effort to demonstrate the advantages of this particular technique of data acquisition. He concluded with a look into the future where the trend toward further integration of the computer into the measurement process continues and accelerates.

Industrial and Environmental Noise

Chairman, G Kerry (Salford University)

The Saturday programme opened with a very popular session, a fact that was proved when most delegates arrived in good time for the 8.40am start. Miss Nicole Porter from the National Physical Laboratory presented the final results from the NPL data sheet study on BS 4142: 1990. The major part of the paper was a summary of the comments and observations reported in these data sheets but Miss Porter concluded with some more personal thoughts on the underlying reasons for problems with the standard. B F Berry, also from NPL and chairman of BSI Committee EPC1/3 the committee responsible for BS 4142, reported on the progress made by the working group set up to recommend minor amendments and clarifications. Delegates were in a privileged position since the proposed changes that he reported and commented on had not yet been before the full committee. Publication of the new edition was expected in the new year but the work of refinement would go on as the results from a number of research projects relevant to BS 4142 currently being undertaken became available.

The background noise correction for measurements of specific noise level $L_{Aeq,Tr}$ of BS 4142: 1990 was the subject of a paper by M Rickaby of the London Borough of Hillingdon and R N Vasudevan of NESCOT. The work presented in the paper had led to the conclusion that the method of carrying out background noise correction which is based on the decibel subtraction of the background noise level $L_{A90,T}$ of the residual noise from the specific noise measurement $L_{Aeq,Tr}$ could lead to errors which may overestimate the specific noise level $L_{Aeq,Tr}$. The fourth paper of the session was given by Dr Bernadette McKell of the Robin Mackenzie Partnership. She discussed the suitability of L_{A90} as a baseline descriptor in environmental assessment and concluded that where possible the L_{A90} value should be used but it is possible that it might lead to a misrepresentation of the subjective calculation of background noise in certain circumstances. Users beware!

The final paper was given by J Sargent of the Building Research Establishment who reported on the results of a recent noise incidence survey of England and Wales. The summary showed that the arithmetic mean $L_{A10,18h}$ for the whole sample was 55.6 dB and this showed little change from a survey carried out by TRRL (now known as TRL) in 1972. Only about 10% of the population have background noise levels at night exceeding 40 dB ($L_{A90,8h}$) 56% have daytime levels exceeding the WHO recommendation of 55 dB $L_{Aeq,day}$ to prevent significant community annoyance.

Instrumentation Applications

Chairman, R Weston (RAF IHMT)

This session was well attended and contained six interesting papers.

The first speaker was A Snell of Cirrus Research plc who described the development of the noise monitoring system which his company had installed at the Humberside Airport some two years previously.

The monitoring system consists of fixed and portable noise monitors which transmit data to a central computer. A development was described that used level/time profiling to identify aircraft generated events in a noisy background. A second development provides for the time history to be displayed on a computer generated map of the area. This was stated to have interested the management in a possible public display in the airport.

The next speaker was J Tingay, also from Cirrus Research, who continued the theme of airport monitoring by reviewing the international perspectives. As he related in his introduction, it would seem obvious that aircraft noise monitoring would be a truly international concept, but, each country has its own set of standards and regulations. The paper described in some detail the numerous variations and combinations that can be played. There was a useful section on flight track correlation and operating systems which ended up with the problems of installation of the hardware in different countries. The conclusion was that this lack of standardisation doubles the cost of an installation.

The next speaker changed tack by talking about investigating domestic noise complaints in Birmingham. J Hinton is a Principal Officer with the Environmental Protection Unit for this authority. Although there are a number of different noise sources which affect householders, it is the noise from neighbours which bothers most people and the resolution of this which presents the biggest problems to local authorities. Their initial approach is to obtain a log of the nuisance and then to use tape recording techniques to resolve the problem where necessary. Tape recording has been made easier with the advent of inexpensive DAT recorders because it is possible to have a time code recorded on them. The author also presented evidence that sheds some doubt on the current perceived extent of domestic noise disturbance and suggested that government should look to the local authorities ability to resolve complaints as a performance indicator. W Davis presented a paper on the same theme but concentrated on the use of inexpensive, unattended, recording equipment. He reviewed the technical specifications of a range of recorders comparing them with an expensive professional make by looking at the frequency response and signal-to-noise ratio. He then went on to consider micro-

phones and concluded that an inexpensive system can be bought 'off the shelf' which would have minimal broadband error for initial screening measurements of domestic noise.

The fifth paper in this section was given by D Hothersall from the University of Bradford. His paper described the practical aspects of measuring sound absorbers in field conditions. The problem is that it is not possible to use impedance tube or reverberation chamber methods to measure the absorption coefficients of earth mounds or willow wall noise barriers. This investigation was into the use of an impulse technique. The results showed that the method was unreliable at frequencies below 500 Hz. However there is scope for further development of this technique.

The final paper was presented by K Horoshenkov, University of Bradford. He has tackled the problem of making scale model measurements of traffic noise, and described development of an ultrasonic whistle for this purpose. Theoretical and practical aspects were presented and the final design to reproduce a monopole source was interesting and shown to be appropriate for modelling of noise propagation.

Building Acoustics

Chairman, L Fothergill (BRE)

At this session which comprised ten papers on the Sunday morning, the high standards of presentation and quality were maintained right to the end of the conference. The first contribution, by Tina Emmanuel of BRE, described a comparison of facade insulation measurements made using the traditional method and the intensity method. She concluded that there was good agreement between the two methods. In the second paper N Tinsdeall from the same establishment concentrated on the sound insulation of windows. He described detailed experiments on many factors that affect performance, and concluded that good sealing was of paramount importance.

G Irvine of Bickerdike Allen Partners also talked about windows and he described a new design to provide sound insulation and ventilation. It was most effective at high frequencies and could provide up to 25 dB Rw. M Wilson of the University of North London continued this low energy design theme by describing his studies of background noise and thermal comfort in naturally ventilated buildings. He found complex behaviour patterns and large differences between people living in different climates.

N-A Andersson who is with Ecophon in Sweden spoke about classroom design in that country, and pointed out that the acoustic quality should be judged by the listeners (children) as well as the talkers (teachers). He made recommendations for reverberation time and the distribution of absorbent for various shapes of classroom. J Miller, a private consultant, was the main author of Sound Control for Homes (published by BRE/CIRIA). After describing the book he talked about some residual design problems which require further study. These included the performance of facade elements (other than windows) and the benefit to be expected from remedial treatments.

Maria Heckl from Keele University described her work to optimise the design of profiled cladding panels. After describing the theoretical model, she showed an impressive video visualisation of the panel vibrating in various modes.

C Hopkins of BRE followed this with a description of the progress he has made on an SEA model of sound transmission between rooms, by comparing predicted and measured results obtained in the BRE flanking laboratory. He concluded that, when non-resonant transmission is significant, sound power levels measured using intensity methods give more appropriate information than energy level differences.

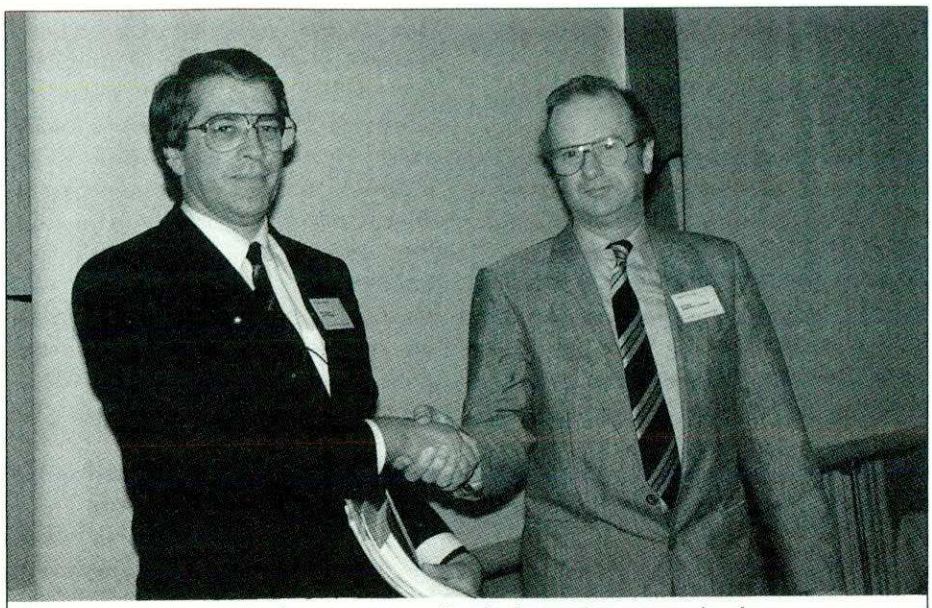
R Mackenzie (Sheffield Hallam University) gave an up-date of his work on developing flexible, cellular polymer based materials, for use as resilient layers in floating floors. He described systems for use on both timber and concrete bases, and gave information on performance. J Seller of South Bank University contributed the final paper of the session on the sound insulation of separating walls built from lightweight blockwork. He found a variety of problems, which were overcome by a lining of try-line board. He suggested that sound insulation requirements should be related to background noise levels.

Workshops

Propagation of Noise: ISO 9613/2

During the Friday afternoon, a well-attended workshop session was held

Dr Herbert Müller giving the Keynote Paper



M Rickaby being presented with the Diploma Prize by the President-Elect, Alex Burd

on this topic. The general outcome of the group discussion was that, with qualifications, a standard such as ISO 9613 was essential. There was general support for the use of summed octave band levels rather than a simple dB(A) scheme such as is either in use or proposed for the calculation of road traffic and railway noise.

The view emerged that a common approach to noise prediction by consultants would be beneficial to the image of the profession with a public who have difficulty accepting that experts in a common field cannot agree on methods of predicting the noise from specific situations.

The major qualification in accepting such a standard was that it had to be useful and accurate and there were doubts expressed that the current version had received sufficient validation to achieve this objective. This was particularly highlighted by the fact that the list of references in the standard omitted a major, validated, investigation into noise propagation, namely that undertaken by CONCAWE. The attitude of BSI was also questioned in that since the UK's initial response that the current document be issued as a Technical Report rather than a standard we had not been represented on the drafting committee. It therefore appeared that the views of the UK were not being included in the development of the standard and that we would miss the opportunity of influencing the final contents. This position would have to be redressed. Bernard Berry reported that, fortunately, at the last meeting of WG 24 sufficient negative votes had been tabled (five) to require a redrafting. The reason for non-acceptance was not known. This redrafting provided an opportunity for further comment and potential representation on the drafting committee. Pressure was needed to be applied to BSI to achieve this.

Regarding possible future action by IOA it was suggested that the appointment of a 'standards officer' to co-ordinate policy on such matters would help ensure that the UK's views on noise matters/standards within Europe would be channelled via the appropriate organisation.

Education for Environmental Noise Measurement.

Later on the same day a second workshop session was arranged which commenced with the presentation by D Bull of a paper by D Bull and T Johnson of the Colchester Institute, 'Certificate of Competence in Environmental Noise Measurement; Course Delivery and Practical Application'. A lively and, at times, somewhat acrimonious discussion followed which aired some conflicting views on this important topic.

Noise Assessment of Mineral Extraction Sites

This was followed immediately by a third workshop which was attended by over 30 delegates including representatives from site operators, local authorities and consultants who work for both sides. Mineral Planning Guidance Note MPG11 was taken as a basis for discussion and the recommended noise limit of 55 dB $L_{Aeq,1h}$ (free field) for noise sensitive properties was covered in detail. The general view was that it was a reasonable standard but there were criticisms from local authorities who preferred the L_{A90} + 10 dB approach and drew attention to problems arising from a creeping background. The site operators highlighted the phasing of developments, resulting in noise exposures being very much short term. It was agreed that as all assessments were made on the basis of 'worst case', this should be taken into account when applying a noise limit. The differences between assessments for fixed and mobile plant were discussed with reference to BS 4142. The application of a 2 dB(A) penalty for wind effects was criticised for being unilaterally applied to all predictions. The use of BS 5228 for noise predictions was covered, with the difficulty of obtaining accurate sound power levels for plant being discussed.

Wind farm noise

A workshop discussion on aspects of wind farm noise was originally scheduled to start at 6pm on the Saturday. However, the bus containing A McKenzie of the Hayes McKenzie Partnership, the workshop chairman, and one of the other speakers broke down on the way back from the Haverigg Wind Farm visit, delaying the start until 7pm. Despite the late start and the frozen condition of some delegates following the visit, the cellar bar was packed with many standing at the rear.

The chairman summarised the principles of electricity generation from the wind and outlined some of the resulting noise issues, including the sources of noise, typical existing noise climates where sites are being or have been developed and the

lack of clear planning guidance. A MacKinnon from National Engineering Laboratories then spoke briefly about the way noise from individual turbines is measured, including the special techniques required because of the nature of the source. He described work currently in progress on an IEC document on noise certification of individual turbines and further work which NEL have carried out on propagation effects.

D Spode from North Cornwall District Council then described the predicament of Environmental Health Officers in which they are caught between wishing to promote renewable energy but also to protect the amenity of local residents. He described typical existing noise climates with L_{90} levels in the low 20s with noise from proposed wind farm developments being in the high 30s and the subsequent possibility of complaints. He pointed out that noise nuisance could be very damaging to the wind industry and that progress in noise control should keep pace with the wind energy contracts.

M Legerton from the DTI Energy Technology Support Unit then described the DTIs renewable energy programme and the PPG on Renewable Energy with its annexe on Wind Energy containing advice on noise issues. He described the DTI working group on noise from wind farms whose purpose is to review the experience gained with regard to noise issues and to produce a framework for such assessment by Spring 1994. He ended with some slides of various wind farm developments from Wales to East Anglia and from Cornwall to North Yorkshire.

A discussion session followed in which it was pointed out that existing technology could be used for noise control, especially for quietening the drive train components which are relatively straightforward. A procedure for evaluating tonal content was discussed with references to work recently carried out for the DoE at ISVR. Specific methods for evaluating tones from wind turbines, with the specific problems that entails, are being taken on board by ETSU. The issues of 'blade swish' was discussed which is an issue which ETSU are also hoping to investigate and quantify. The relative unpopularity of vertical axis turbines and lattice towers was queried with comments being made on additional noise, visual issues and structural integrity of lattice towers. The issue of planning gain was discussed and the conflict which this poses with regard to the Environmental Protection Act.

The possibility of financial subsidies based on noise emission was brought up together with the possibilities of wind farm operators being required to shut-down at night. It was acknowledged that the discussion session could have gone on for a further two hours but delegates departed for a well-deserved conference dinner by 8.30pm.

Conference proceedings for the two 1993 Windermere conferences are available for purchase.

Acoustic Analysis of Disordered Speech and Voice

10 November 1993, University of Newcastle-upon-Tyne

This half-day Speech Group workshop united speech researchers and voice researchers, with many new faces. The first paper, by Jocelynne Watson (Queen Margaret College, Edinburgh) and Sally Bates (University of Edinburgh), was on 'Consonant effects on vowel production: acoustic investigation in children's speech'. They presented data from disordered children's speech in Scotland. Next, Alan Wrench (University of Edinburgh) spoke on 'A speech therapy workstation' which is being developed to help patients who have had part of the tongue surgically removed. He demonstrated its use and spoke about the results obtained so far, showing an improvement among those patients using it. Takao Mizutani (University of Electro-Communications, Japan) spoke on 'Analysis of tongue motion based on high speed electropalatographic data', discussing the use of this data in the investigation of vowel articulations. Anja Leuschel and Gerry Docherty (University of Newcastle) spoke next on 'Application of acoustic techniques in the analysis of dysarthric speech', followed by Martin Ball (University of Ulster) and Joan Rahilly (Queen's University Belfast speaking on 'Acoustic analysis as an aid to the transcription of dysfluent speech'.

A short tea break intervened, followed by a talk by Colin Watson (Queen Margaret College, Edinburgh) on 'A feature analysis of jitter in Parkinson's patients', showing pitch traces from various patients under study. Nigel Hewlett and Wendy Cohen (Queen Margaret College, Edinburgh) then spoke on 'Voiceless sounds in electrolarynx speech', explaining how laryngectomy patients use the electrolarynx to produce a voicing buzz for speech, and the characteristic difficulties they have in realising voiceless sounds in such speech. There followed a talk (presented by Leon Lindsay) by Leon Lindsay, M Dutton, C Rigby and P Carding (Freeman Hospital, Newcastle and University of Central Lancashire) on 'Low-cost clinical assessment of voice characteristics and pathology using a 'Soundblaster 16' multimedia sound-card and an IBM compatible PC'. This talk described a set-up that had already been implemented in clinical practice on an experimental basis. Finally, Leon Lindsay and Paul Carding (Freeman Hospital, Newcastle) gave a paper on 'Production of hoarseness in vowels by artificial introduction of cyclical changes in their frequency and intensity'.

The meeting was organised by Dr Gerry Docherty.

Briony Williams ❖

CODE AND RULES OF CONDUCT FOR MEMBERS OF THE INSTITUTE OF ACOUSTICS

The Code and Rules of Conduct of the Institute which members of the Institute have seen and agreed to abide by have been in existence for many years. During recent years there have been comments from within the Institute that at some points the intention is open to misinterpretation while the failure to lay down any disciplinary procedures was commented on by the Engineering Council. The Membership Committee has accepted these criticisms and, during the last year, has drawn up a revised version which was accepted by Council at its meeting on 9 December 1993.

The intent of the new Code is unchanged from the earlier version. As stated in the preamble, it is the aim of the Code that members shall have a professional commitment to a standard of excellence in their work and in their dealings with other people. In all situations it is the expectation that in a conflict of interests between member's personal interests and those of the wider community, the latter should take precedence.

We reproduce the revised Code and Rules hereunder and I commend them to you all for the maintenance of the integrity of the acoustic profession.

Alex Burd FIOA, Chairman, Membership Committee

Preamble

In the Institute's Articles of Association there is a general requirement for members* to be bound to further the aims of the Institute to the best of their abilities. The standing of the Institute is enhanced if its members are not only well qualified, but also have a professional commitment to a standard of excellence in their work and in their dealings with other people.

A Code of Conduct designed to embody broad ethical principles is necessarily drawn up in general terms. The Rules of Conduct indicate the manner in which members are required to conduct themselves in most situations. For situations not specifically encompassed by the Rules, the principle to be followed is that, in any conflict between a member's personal interests and those of the wider community, the latter should take precedence.

Any person who wishes to bring a complaint or information relating to alleged improper conduct or breach of the Institute's Code and Rules of Conduct should contact the Chairman of the Membership Committee who will follow a defined procedure.

Code of Conduct

Every member of the Institute shall at all times so order his conduct as to uphold the dignity and reputation of his profession and to safeguard the public interest in matters of safety, health and the environment. He shall exercise his professional skill and judgement to the best of his ability and discharge his professional responsibilities with integrity.

Rules of Conduct

For clarity, these rules have been grouped into the principal duties which all members should endeavour to discharge in pursuing their professional lives.

Professional Competence and Integrity

1. A member has a responsibility to upgrade his professional knowledge and skill and shall maintain an adequate awareness of technological developments, procedures, standards, laws and statutory regulations which are relevant to his field and shall encourage his subordinates to do likewise.

2. A member shall not knowingly act for a client for whom another member is acting in the same matter until either the first contract has been determined by the client or the other member has consented to his acting.

3. A member shall not maliciously or recklessly injure or attempt to injure, whether directly or indirectly, the professional reputation of another.

Public Interest

4. A member shall not do anything, or permit anything under his authority to be done, of which the probable and involuntary consequences would, in his professional judgment, endanger human life or safety, expose valuable property to the risk of destruction or serious damage, or needlessly pollute the environment, except when legally authorised to do so.

5. In his work, a member shall respect all relevant laws and statutory regulations.

Duty to Employers

6. When discharging his professional duties a member shall:

(a) satisfy himself as to their scope, obtaining in advance any necessary clarification or confirmation, and shall not accept professional obligations which he believes he has not sufficient competence or authority to perform;

(b) accept responsibility for all work carried out by him, or under his supervision or direction, and shall take all reasonable steps to ensure that persons working under his authority are competent to carry out the tasks assigned to them and that they accept responsibility for work done under the authority delegated to them;

(c) give advice that is objective and, as far as practicable, reliable and if this advice is not accepted, take all reasonable steps to ensure that the person who over-rules or disregards his advice is aware of the possible consequences;

(d) disclose to his client or employer any benefits or interests that he may have in any matter in which he is engaged on their behalf;

(e) neither communicate to any person, nor publish any information or matter not previously known by him or published in the public domain, which has been communicated to him in confidence by a client or employer

without the express authority of that client or employer;
(f) not offer or give or receive any inducement (financial or otherwise) to or from a third party in return for the introduction of clients or professional assignments without making such action known to the client.

Procedures

In the event of a complaint or the bringing to his notice of information relating to alleged improper conduct or breach of the Institute's Code and Rules of Conduct, the Chairman of the Membership Committee shall appoint from the members of the Committee a member or members to carry out an investigation into the facts of the submission and report to the Chairman. If he deems it appropriate a meeting of a Disciplinary Panel will be convened which reports back to the Chairman. The Disciplinary Panel shall comprise all members of the Membership Committee excluding any with a direct interest in the case.

The Chairman of the Membership Committee reports the findings to Council which shall determine the appropriate course of action. Where dismissal is considered to be appropriate, the member has a right of appeal to Council and subsequently to a General Meeting as defined in the Articles of Association.

Council shall arrange for all interested parties to be informed and may, at its discretion, publish the results.

**In these rules 'member' means a member of any class referred to in the Bylaws and 'employer' includes client. All references in the masculine gender shall apply equally to women. Chartered Engineers and Incorporated Engineers are also subject to the Code and Rules of Conduct of the Engineering Council.*

The 1994 Environment Award for Engineers

The Engineering Council has launched its 1994 Environment Award for Engineers, the prestigious annual competition that demonstrates how engineers are making positive contributions to protecting the environment.

The Award is open to individuals who must be registered with the Council as Chartered Engineers (CEng), Incorporated Engineers (IEng) or Engineering Technicians (EngTech), or to teams of engineers and technicians which must include at least one member who is registered.

The award has first, second and third prizes of £3000, £2000 and £1000 respectively.

Entrants must have been responsible for the design, manufacture or construction of an engineering project or process which provides an engineering solution to an environmental problem.

Details of the competition and entry forms can be obtained from:
The Engineering Council, 10 Maltravers Street,
London WC2R 3ER Tel: 071 240 7891.

The Institute and Continuing Professional Development

Peter D Wheeler FIOA

Many members, including those who are also members of the Institution of Environmental Health Officers or of one of the engineering institutions, will be aware of the increasingly high profile that Continuing Professional Development (CPD) has acquired recently.

The President has set up a working party to consider the role of the Institute in the formal CPD process. In this article, based on its initial discussions, he reviews some of the CPD initiatives of other professional bodies and identifies a number of issues for IOA members to consider.

What is CPD?

CPD has been defined by other institutions that are particularly active in this work as 'The systematic maintenance, improvement and broadening of knowledge and skill and the development of personal qualities necessary for the execution of professional and technical duties throughout the practitioner's working life.'

In defining CPD in such terms, and this seems adequate for the purpose, it is clear that the needs of the individual, his or her employer and society are recognised. Charles Handy, the well-known management consultant and author, has suggested that many individuals never realise more than 20% of their true potential in their professional life. The reasons behind such failure to exploit an individual's capabilities might be argued to lie in our education system, in the attitude of employers, or in the problems facing society nowadays, but must, in part, rest with the individual.

'CPD should not be regarded as an imposition. Everyone is continually developing as they progress through life, not just professional people. CPD is a structured approach to ensure that as civil engineers we remain up to date with current developments' says Jane Alderson, an Institution of Civil Engineers council member.

Methods of Achieving CPD

In practice CPD, as it has so far developed, is about an essentially structured approach to the participation in a variety of activities aimed at achieving the goals set down in the assumed definition. The activities are taken to lie outside the routine reading of publications and so forth which it is assumed professional individuals automatically undertake.

Examples of relevant CPD activities are:

Personal

- Structured reading
- Writing articles
- Research work
- Further education
- Active committee involvement
- Distance learning courses

Collective

- External courses, seminars and conferences
- In-house activities
- Institution meetings and seminars
- Organised visits
- Institution activities (eg, as a Reviewer)
- Job rotation/exchanges/secondments

There are two dimensions to CPD activities – the professional/personal development dimension and the highly structured/unstructured dimension.

The general view among professional institutions seems to be that an individual should be able to demonstrate that he or she has, in any one year, engaged in CPD activities equivalent to some 20 to 35 hours of structured activity. Some institutions require that at least 70% of this is in core professional areas. Some require at least 25% to be in the personal skills development area rather than the professional or technical area. Others suggest that 'less relevant' personal development activities such as language courses can be included but are rated at the equivalent of 50% of the time involved.

Individuals are frequently encouraged to keep a Personal Development Portfolio which may be called for by their institution as a record of their CPD achievements. This helps the review process when members are required to present evidence of their responsible experience when seeking promotion to a higher grade of membership.

Benefits of CPD

One issue on which all the professions seem to agree is that of 'Ownership'. The individual is encouraged to examine his or her own CPD needs in the light of the guidance given, and to identify and undertake the appropriate actions. The institutional role is to generally facilitate the process, provide the framework within which individuals can develop, and be involved in the assessment and control of the quality of provision. The benefits of CPD are seen as:

To individuals

- Basis of a personal development plan
- Improved professional competence
- Increased job satisfaction
- Better earning power
- Evidence of up-to-date competence
- Wider contacts

To Employers

- More capable staff
- Better qualified staff
- Increased staff retention
- Improved marketability

To Institutions

- Improved public perception

- Increased professionalism
- Better communications

Voluntary or Mandatory? - Other Institutions' Views

Initially most professional bodies worked on the basis that the involvement in CPD for an individual is on a voluntary basis. There is, at present, a strong move in some areas towards a mandatory basis. This is based on the argument that, for professional insurance and for legal reasons, a practitioner must be able to show competence in a changing technological field if he or she wishes to claim membership of the profession.

A number of institutions, among them a large group of bodies in the construction area which includes the Chartered Institute of Building, the Institution of Civil Engineers, Royal Institution of Chartered Surveyors and the Royal Institute of British Architects, have adopted the term 'obligatory'. This is taken to relate to the obligation of the member to observe the rules of the professional body, which in the case of ICE, for example, say 'a member shall afford such assistance himself, or through his organisation as an employer, as may be necessary to further the formation and professional development of himself and of other members and prospective members of the profession in accordance with recommendations made by Council from time to time.'

The Institute

Some issues for the Institute would seem to be

- Should the Institute establish a CPD scheme for its own members? (and indeed for its staff).
- Should, and can, the Institute improve its services to members and to the profession by providing a CPD service through, for example, its learned society programme and branch meetings, for those IOA members who are also members of other professional organisations and addressing their CPD obligations for these other bodies?
- Can the Institute utilise its resources, such as the published volumes of IOA proceedings, as a CPD/research resource?

Members' Views

The Institute's CPD working party would be pleased to hear members' views, particularly on the following questions. Comments should be sent to the Institute office.

- Should the Institute set up its own CPD system in general accordance with the form of CPD proposals in other professional organisations?
- Should such a system be voluntary, obligatory or mandatory? If obligatory or mandatory, what sanctions, if any, would be appropriate for non-compliance?
- Is there a role for recorded CPD activities in the Institute's procedures for election to grades of membership?
- Can you identify other IOA facilities or activities which might help members or others fulfil their CPD needs?
- Should the Institute seek to formalise arrangements with other professional organisations so that their members may more readily present attendance at IOA conferences and meetings as counting towards their CPD needs?

The Institute Diploma Examination

John Bowsher FIOA

Report on the 1993 Examination

The numbers of candidates gaining Merits, Passes or Fails in each Module are shown for each Centre in the Table of Results. The total number of candidates was 218 (228 last year) and the overall pass rate 85.5% (82.5% last year), including all projects. Candidates who did not submit their project report by the set date are shown to have failed in the project.

As is now usual, most matters of administration proceeded smoothly; unfortunately two misprints escaped all the proof reading and actually appeared on the final papers. The amount of work needing to be done after scrutiny was even less than in 1992 and there were very few problems for the Chief and Deputy Chief Examiner at their final written paper moderating session in August. Difficulties were caused by some centres misinterpreting the revised project arrangements: the intent of the revision was to allow candidates prevented, by circumstances beyond their control, from submitting at the normal July date, or else whose project report was, in the opinion of their tutor, not quite up to standard, to submit in November. Instead these centres allowed their candidates ab initio to prepare for a November submission, thus creating some confusion.

In the 1993 Diploma, the General Principles of Acoustics Module was assessed partly by course work. Laboratory reports and assignments set throughout the year were graded and contributed 20% of the total mark. The overall practical effect has been to raise the mean mark by 2.5% and reduce the standard deviation from 13.7 to 12.4. The coursework formed a 'hurdle' for the first time, and two candidates failed the whole paper for this reason.

Changes for future examinations

Richard Galbraith MIOA, of Sandy Brown Associates, has agreed to become the specialist examiner for the Architectural and Building Acoustics paper with effect from the 1994 examination.

Preparations for a new syllabus are under way and a Diploma Working Group has been set up to examine afresh the whole structure of the Diploma in time for the 1995 Diploma examinations. Aspects receiving special scrutiny are the inter-relationship of the General Principles of Acoustics paper and the specialist papers and the role of the project with increasing demands on staff time. The Chief Examiner would welcome views from the membership on the future of the Diploma.

	General Principles of Acoustics			Architectural and Building Acoustics			Law and Administration			Noise Control Engineering			Sound Reproduction			Transportation Noise			Vibration Control			Project			Overall		
	Merit	Pass	Fail	Merit	Pass	Fail	Merit	Pass	Fail	Merit	Pass	Fail	Merit	Pass	Fail	Merit	Pass	Fail	Merit	Pass	Fail	Merit	Pass	Fail	Merit	Pass	Fail
Bristol	1	10	1	0	0	0	1	9	1	0	11	1	0	0	0	0	0	0	0	2	0	2	8	3	4	40	6
Colchester	3	10	0	0	0	0	2	6	1	3	10	0	0	0	0	0	0	0	1	3	0	2	11	0	11	40	1
Cornwall	0	3	0	0	3	1	0	4	1	0	0	0	0	2	0	0	4	1	0	0	0	1	2	4	1	18	7
Derby	3	34	1	0	0	0	0	20	3	3	15	3	0	0	0	8	21	3	0	0	0	7	27	6	21	117	16
Heriot-Watt	0	3	1	1	0	1	1	1	0	0	3	0	0	0	0	0	1	0	0	0	0	0	1	0	2	9	2
Leeds	1	21	1	0	0	0	2	16	6	2	15	2	0	0	0	0	6	0	0	0	0	0	10	7	5	68	16
Liverpool	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	4	3	0	7	4
NESCOT	2	27	3	2	12	0	0	17	1	4	17	2	1	1	0	1	16	2	0	0	0	2	25	11	12	115	19
Newcastle	0	0	0	0	12	1	0	0	0	0	11	2	0	0	0	0	0	0	0	0	0	3	8	2	3	31	5
Sheffield	0	2	0	0	2	1	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	1	4	0	1	11	1
South Bank	3	18	1	3	9	4	1	4	2	3	13	2	0	0	0	1	8	1	0	0	0	3	12	11	14	64	21
	13	129	8	6	38	8	7	78	15	15	98	12	1	3	0	10	57	8	1	5	0	21	112	47	74	520	98

Diploma in Acoustics and Noise Control
Grades awarded to 1993 candidates from each centre

1993 Diploma Pass List

NESCOT
Austin, M J
Barnes, B I
Brisk, S
Duffett, K J
Dutfield, P R
Evans, G J
France, A J
Gittins, A E
Haynes, R
Hetherington, A J
Hill, J M
Hooper, I G
Houska, M A
Hunte, O D
Jolly, K A
Kellett, P
Kern, A S
Leddy, Y
Lewis, S
O'Neill, D J
Patel, R
Preston, A L
Reynolds, B J
Rickaby, M F
Rowntree, R A
Slaughter, P A
Whitby, A J
Whiting, R S
Wilmot, N J

Liverpool
Allsopp, E R S
Hall, K J
Johnston, R A
Parker, E L
Yates, W

Newcastle
Boundy, S
Bower, D J
Fitzpatrick, J K
Johnson, W S S
McLaverty, B M
Pearson, A W
Smith, S
Todd, S J
Wilson, G

Cornwall
Bray, A J
Irving, A M
Jiggins, M

Leeds
Bannigan, T
Cragg, J
Fox, A D M
Kirkby, C A
Mitchell, C G
Petrie, A S
Smith, K A
Thorne, C J
Tomlinson, L
Turrill, C C

Bristol
Breen, A
Brine, R
Edmunds, B K
Gandy, S J
Gardner, A J
Guy, N T
Horne, T J
Jones, N J
Mathieson, A
Wood, A J

Derby
Baker, S H
Barnes, R
Beaver, G M
Bide, J L
Bond, A G
Branson, S
Brown, K
Bukowski, P
Burdis, S J
Butcher, D R
Cherry, J R
Choo Yin, C
Deacon, M
Dowbenko, D N
Evans, J
Goodier, M
Hannaby, R A
Jellyman, A S
Kemp, C
Kimmitt, J M
Lefebure, M A
Ley, A K
Lycett, A P
Mitton, K
Reading, J M
Shields, P J
Shingler, H
Todd, J A
Walters, R D
Woodhouse, J S
Worwood, M D J
Zarebski, T R

Colchester
Barrell, D J
Cassidy, R
Eisenhauer, A J
Ellerby, R V
Farr, R W
Netherton, A M
Paddon, I D
Rowe, D
Smith, G A
Swainston, N J
Walker, M C
Wells, M

Heriot-Watt
Dolling, R

Sheffield
Elleker, A D
Lawrance, M H
Thornton, P
Tocher, M D

South Bank
Brown, R S
Childerhouse, S A
Cork, P V
Dolan, W J
Eames, E A
Hallett, T M
Hancock, M K
Hawes, J M
Howard, C
Hurrell, A M
Keetoon, A
Labarr, W J
Lorenzetto, R
Miller, I M
Renton, S G
Rowntree, R H
Smith, A G
Walmsley, A

Additional Modules
The following Diploma holders have passed additional specialist modules

NESCOT
Catchlove, R A F
Blazdell, S M
Crabtree, S R
Baldock, A P
Cresswell, E K

Bristol
Kerr, N G

Derby
Belton, C R

Diploma in Acoustics and Noise Control

Tutored Distance Learning

This mode of study is primarily intended for students who find difficulty in attending a conventional course. The tuition pattern involves the programmed distribution of written material and exercises supported by a schedule of tutorial contacts and laboratory work. In addition candidates have to satisfactorily complete an investigative project.

Face-to-face tutorial arrangements are normally based on programmed meetings in small groups with an approved tutor at regular intervals. Because of the variable travelling distances involved, these can be arranged by the tutor on an individual basis.

There are two course commencement dates each year. The first is in April for which the teaching programme extends over four academic terms. The second course begins in the October and lasts for three terms. Both courses prepare candidates for the IOA examinations in the June of the following year.

For the April entrants the General Principles of Acoustics module is taught during the summer and autumn terms, with the two optional modules and the project in the spring and summer terms. For October entrants the General Principles of Acoustics module is taught during the autumn term and part of the following spring term. The two optional modules and the project occupy the remainder of the spring term and the following summer term.

The normal minimum requirement for admission to the Distance Learning Course is a degree in a science, engineering or construction-related subject or an Environmental Health Officer's Diploma; other qualifications may be acceptable.

Students electing to follow this method of teaching face the same examination and course work requirements for the award of the Diploma as those studying by the conventional route.

Group & Branch News

About 80 people crowded in to the Teak Room at the Hydro Hotel at about 10.30 pm on the Saturday night at the Windermere Environmental Noise Conference in order to discuss the future role and activities of the Environmental Noise Group. The Group Chairman, Stephen Turner MIOA, proposed a number of possible activities for the group including: organising meetings, involvement with the IOA Environmental Noise Certificate, involvement with the Noise Council and acting as a source of informed comment within the Institute on environmental noise matters. The meeting was very enthusiastic about the formation of the new group and gave broad support to these suggestions.

Following this promising start a group committee has been formed with the aim of achieving a wide geographical representation combined with a mixture of professional interests. Besides the chairman, the committee comprises Ken Collins MIOA of Ashdown Environmental who becomes the group hon treasurer, Dawn Langdon MIOA from the Borough of Basingstoke and Deane who is the group hon secretary, Bernardette McKell MIOA of Robin Mackenzie Partnership, Nicole Porter MIOA of NPL, Mike Squires MIOA of Exeter City Council and Colin Waters FIOA of Colin Waters Acoustics. The first committee meeting has been held and good progress was made on developing a plan of action. Further details will be announced in the next Bulletin.

The formation of the new group will mean a change in the emphasis of the activities of the Building Acoustics and Industrial Noise Groups, which have previously been involved in meetings on environmental noise topics.

The Building Acoustics group will now concentrate on architectural acoustics, sound insulation and on noise in buildings. The Industrial Noise Group will cover such aspects as machinery noise, engineering noise reduction techniques, noise in the work place and hearing protection. It is obvious, however, that there is a great deal of overlap of interest between the three groups and their committees will work closely together.

Members who have indicated on their membership fee forms a principal interest in one of these three groups will receive mailings as though they are members of all three.

As Vice President for Groups and Branches, I would be particularly interested to hear from members with a special interest in physical acoustics, in order to maintain the Institute's interest in the joint Institute of Physics/ Institute of Acoustics Physical Acoustics Group. For those who may be uncertain, from the point of view of the group's activities, physical acoustics is taken to cover the physical aspects of the generation, propagation and detection of elastic waves in general. For this reason much of the work is essentially research oriented and relates primarily to the ultrasonic domain up to GHz frequencies. High power and industrial applications also fall very much within the group's remit.

R J Peters FIOA

Contributions

Serpents and Synthesisers

The Institute of Physics Education Group Lecture for Schools 1993/94 presented by Dr Murray Campbell MIOA, University of Edinburgh

Have you ever been to a show or a concert, or even a physics lecture, that held you enthralled for an hour or more and left you at the end wishing it could just carry on? Serpents and Synthesisers was like that. For those that don't know, Serpents and Synthesisers is the Institute of Physics 1993/94 Lecture for Schools. It has been on tour since last October and continues until July – there's a list of future venues below, along with an address for more information. If it's coming your way, I urge you to get along, and take the family and all your friends with you!

The lecture for this season is presented by Murray Campbell of Edinburgh University and, as you might guess from the title, it is about musical instruments. In fact, it's even simpler than that – it's about a bugle call. The lecture starts with a brief but convincing explanation of what sound is. Then, with a little help from an FM synthesiser, a spectrum analyser and a few of the vast array of musical instruments that Dr Campbell seems to be able to play, he demonstrates that (most) musical sounds are characterised by harmonic spectra. From there it is a simple step to show that you can play a bugle call with a series of harmonically related notes or, vice versa, if you have a string or a tube with a number of natural modes of vibration, and if you can play the bugle call using these natural modes, then they must form a harmonic series.

That's the easy bit. We were then given a bugle call on harmonics from most of the instruments on show – a synthesiser, a viola and an alphorn to name just three – and some things that were not instruments – a length of corrugated tubing swung round the head for example. I know that in principle the higher string modes in guitars and violins can be sounded by gently touching a finger in the right place – I've even managed to do it on occasions – but being able to choose just which mode sounds and when with the precision needed to play a tune seems well beyond the normal capabilities of a musician, let alone an acoustician.

After that, the lecture progressed to explanations and demonstrations of some of the more unusual instruments, including the serpent from the title, a few words about percussion, an explanation of how synthesisers work, and then the grand finale, 'The Trumpet Shall Sound' from the Messiah played on a piece of plastic pipe, a trumpet mouthpiece and a funnel and accompanied with the spare hand (!!!) on the synthesiser.

Yes. This show should not be missed. Between now and July the lecture will be visiting UMIST, Manchester (March 14), the University of Surrey (March 15), the University of Brighton (March 16). the University of Liverpool (March 17), the University of Lancaster (March 18), The University of Kent at Canterbury (April 18), The University of Essex (April 19), King Henry VIII School, Coventry (April 20), Loughborough Grammar School (April 20), Wulfrun College, Wolverhampton (April 21), the University of Newcastle (April 22) and The Royal Institution London (July 4).

Admission is by arrangement only, and further details may be obtained from your local Institute of Physics branch or from Catherine Wilson, Education Manager, The Institute of Physics, 47 Belgrave Square, London SW1X 8QX, Tel: 071 235 6111.

BRE

Building Research Establishment Reports on Noisy Neighbours and the UK Noise Climate.

Over 50% of homes in the UK are exposed to daytime noise levels exceeding the World Health Organisation recommendation, rising to 63% at night, according to BRE research on the noise climate around homes and its effects on occupants. The study, based on noise levels recorded for 24 hours outside 1000 individual homes in England and Wales over a one-year period, showed that traffic noise was noticeable outside 90% of properties, although only 5% faced main roads, and 7% of homes were above the qualifying level for sound insulation for new homes.

A BRE noise attitude survey of over 2000 households showed that although traffic noise is heard by the greatest number of people in their homes, noisy neighbours, once heard, give rise to the biggest proportion of objections. The survey identified common sources of environmental noise and typical human reactions, which are partly determined by factors such as age, sex, lifestyle and personality.

Copies of IP 21/93 'The noise climate around our homes' and IP 22/92 'Effects of environmental noise on people at home' are available from the BRE Bookshop, Building Research Establishment, Garston, Watford WD2 7JR. Tel: 0923 664444, price £3.50 (plus 35p p&p) each.

BRE has published guidance on improving sound insulation in the home, also available from the BRE Bookshop. Leaflet XL4 'Improving sound insulation in your home', £2 (plus 20p p&p) and BR 238 'Sound control for homes' BRE/CIRIA, £40 (plus 40p p&p).

Acoustic Celebrations in Poland

From 14–17 September 1993 Polish acousticians attended the 40th Open Seminar in Acoustics at Polanczyk in the South East of Poland organised by the Rzeszow division of the Polish Acoustical Society in cooperation with the Committee on Acoustics of the Polish Academy of Sciences (PAN), the Institute of Fundamental Technical Research of PAN in Warsaw, and the Institute of Physics of the Pedagogical University of Rzeszow. Almost 200 delegates attended the meeting, including guests from the Ukraine, Turkmenistan, Germany and the UK. The programme consisted of 6 plenary lectures, 83 proffered papers (in 3

parallel sections), 9 poster presentations, a banquet, a bonfire and a choice of 5 fascinating excursions. The proffered papers were in the areas of aeroacoustics, underwater sound, structural acoustics and vibration, bioacoustics, general linear acoustics, ultrasonics, noise control, physiological and psychological acoustics, signal processing, architectural and environmental acoustics, speech production, perception and processing, and music and musical instruments.

Not only was the occasion to celebrate the jubilee of the 40th Open Seminar in Acoustics, it was also a celebration of thirty years of the existence of the Polish Acoustical Society. The Honorary Member and the Senior of the Society, Professor Ignacy Malecki (in his 80th year) introduced the opening plenary paper by Professor Zenon Jagodzinski, the Honorary Member and the former President of the Society, (also in his 80th year) which comprised some reflections on the first thirty years of the Polish Acoustical Society. He mentioned the fact that only in 1982, due to the Martial Law situation, the Open Seminar in Acoustics had not taken place. In addition to this main general annual meeting, there are a number of regular specialised meetings: the Annual Winter School on Molecular and Quantum Acoustics (which has been held for 23 years), the Annual Winter School on Noise and Vibration Control (22 years old), the Spring School on Acousto-optics organised every three years since 1980, and the Annual Symposium on Hydroacoustics, started in 1984. In addition in 1981 a conference sponsored by the International Council on Acoustics on the subject of acoustics education and development was organised in Gdansk. The fact that almost without exception these activities continued (and indeed several were started) during the turbulent times of the 1980s gives great hope for the future.

Register of Speakers on NDT

The British National Committee for Non-Destructive Testing has long pursued the objective of increasing awareness of NDT in places of further and higher education. To this end, the BNC in co-operation with the British Institute of Non-Destructive Testing, is compiling a register of speakers willing to travel within a reasonable geographical area and lecture on NDT.

Initially the main purpose of the Register will be to have the capability of offering a speaker to give a general introduction to NDT, to make students aware of its possibilities and of its needs vis a vis engineering design. Depending on the interest generated, it may be possible to develop the service to offer talks on specific NDT techniques.

Anyone interested in entering their name on the Register should, in the first place, write to the BNC Secretariat at 1 Spencer Parade, Northampton NN1 5AA. Also anyone interested in providing a link between the Institute and the British Institute of NDT in place of Dr Bob Chivers, who has had to withdraw on account of other pressures, should contact Cathy Mackenzie.

BS 5839

It is widely accepted that the existing fire alarm Code of Practice, BS 5839: Part 1, does not adequately describe the requirements for voice alarm systems. The publication and application of BS 7443 (IEC 849) 'Sound systems for emergency purposes' has further complicated matters.

A working group of the British Fire Protection Systems Association (BFPSA) is currently preparing a code of practice to fill the gap. This is likely to be published initially as an industry code but is intended to form future additional parts of the BS 5839 series or a future dual European/British standard.

The group is working closely with the Sound and Communication Industries Federation (SCIF) committee which has prepared a draft revision of IEC 849. The SCIF work includes an IOA working party which has advised on speech intelligibility clauses within IEC 849, the deliberations of which are discussed elsewhere in this issue.

Unification of the Engineering Profession

The following communication has been received from Sir John Fairclough

It is now nine months since the report of the Steering Group for Stage I of the investigation into the Unification of the Engineering Profession, 'Engineering into the Millennium', was published. We have not been standing still during this period and are now well into the second stage of the project. It is important that everyone is kept informed of our deliberations and this newsletter is the first in a series that will report on the progress towards the development of a unified engineering profession.

The Millenium Report received a great deal of comment from a broad constituency of engineers – from Institutions, industry and individuals. There is almost universal support for the concept of a 'New Relationship' between a reformed Engineering Council and the Institutions. But there is less agreement as to how this relationship might be achieved. The majority of respondents accepted the need for some form of grouping of the Institutions for various purposes. But the college concept set out in the Millennium report did not find favour and will not be pursued in Stage II of the investigation.

There is support for a study of next steps for the profession beyond the New Relationship. This would embrace the concept of a federal arrangement that would meld the Institutions and a reformed Engineering Council into a powerful single voice for issues best dealt with at the centre, but would also allow the Institutions to retain their individual identities and roles.

In order to carry the work forward, a Policy Group has been set up under my Chairmanship to undertake Stage II of the investigation.

The Group is made up of senior representatives of a number of the engineering Institutions and four members of The Engineering Council.

The Group has agreed its terms of reference and approved a budget for Stage II . These were sent to the Presidents of the forty two Institutions in October.

The Group's main priority is to establish a proposal for the New Relationship, which will be put to the Council of Presidents of the Institutions, The Engineering Council and the profession as a whole by the Autumn of 1994.

To this end, a New Relationship Working Group, consisting of a Chairman and Vice Chairman drawn from the Policy Group, an Engineering Council Director and the Secretary of an engineering Institution, has been appointed by the Policy Group to take the work forward.

The Working Group, which reports to the Policy Group at monthly intervals, has agreed its terms of reference and is now getting to grips with a range of issues that need to be addressed in the preparation of a detailed plan.

A second Working Group has been set up to study the need or otherwise for new legislation to regulate the profession, and a third Working Group will be appointed early in 1994 to consider possible next steps for the profession beyond the New Relationship.

It is the Policy Group's intention to maintain a tight timescale on the Stage II study with the aim of publishing proposals for the New Relationship by the Autumn of 1994 and electing a reformed Engineering Council in June 1995.

EC noise standards for heavy trucks

The University of Southampton's Institute of Sound and Vibration Research (ISVR) is a partner in a three year research programme which aims to help European manufacturers of heavy road vehicles meet the forthcoming EC legislation on roadside noise.

ISVR is collaborating with the Catholic University of Leuven in Belgium to assess the accuracy and ease of application of various forms of mathematical model and associated analysis for the prediction and optimisation of engine enclosure performance, with particular emphasis on sound leakage through apertures.

The theoretical predictions will be compared with measurements made on trucks by other partners including DAF, Renault and Fiat, and will be based on experimental characterisations of the engine as a noise source by TNO in the Netherlands and Brüel and Kjær in Denmark.

The ISVR contribution to this three year project is led by Professor Frank Fahy, assisted by Dr Nicholas Lalor, Malcolm Smith of ICS and research staff Jeremy Lea and Russell Thompsett. The Group have recently been awarded £100,000 by the EC to support their research.

For further information contact Professor Frank Fahy FIOA, ISVR, University of Southampton Tel: 0703 592399.

Contributors Peter Dobbins MIOA, Editor, Dr Bob Chivers FIOA, IOA office, Rob Harris FIOA, Sir John Fairclough, ISVR ❖

Hansard

21 October 1993

Noise Abatement Zones

Mr Pike: To ask the Secretary of State for the Environment what conclusions he has reached on consideration of the Building Research Establishment's report in relation to noise abatement zones; and if he will make a statement.

Mr Yeo: My Department is considering the effectiveness of noise abatement zones in the light of the findings of the Building Research Establishment's 'Review of Noise Abatement Zones in England and Wales 1976–1992'. The review showed that the procedure for establishing and monitoring NAZs was complex and resource intensive for all the parties involved. In reaching conclusions, we must balance the need to limit the regulatory burden on businesses with the continuing need to deal effectively with noise pollution.

Noise

Mr Pike: To ask the Secretary of State for the Environment how many complaints relating to noise have been (a) reported to local authorities and (b) investigated by local authorities under the Environmental Protection Act 1990.

Mr Yeo: The Department of the Environment 'Digest of Environmental Protection and Water Statistics' HMSO 1992 indicates that during 1990–91, 136,609 complaints about noise were received by local authorities, relating to the Control of Pollution Act 1974 and the Environmental Protection Act 1990. Of these, 31,721 were considered to be justified as statutory nuisances and in 6,113 cases abatement notices were served.

The 1990 Act came into operation on 1 January 1991 and separate figures for the number of complaints investigated under that Act in 1990–91 are not available.

1 November 1993

Aircraft Noise

Mr Llwyd: To ask the Secretary of State for Defence if he will make a statement on the progress of the joint United Kingdom–United States–Canadian study on the long-term effects on human health of exposure to aircraft noise; and if he will list any publications by participants in this study.

Mr Hanley: Initial work on the feasibility of a study to investigate the possible effects on health of noise from low-flying aircraft has been completed and a report is being prepared. My Department is not aware of any publications by participants in relation to the study.

2 November 1993

Aircraft Noise

Mr Llwyd: To ask the Secretary of State for Defence if he will make a statement on the progress of his Department's research and development programmes in the arcas listed in appendix II to the annex to the summary of the final report of the NATO CCMS pilot study on aircraft noise in a modern society.

Mr Hanley: My Department is involved in several studies to further the understanding of noise associated with military aircraft. In parallel, we continue to develop noise modelling and prediction capabilities. In collaboration with authorities in the United States and Canada we have completed initial work into the feasibility of a study to investigate the possible effects on health of noise from low flying aircraft, and a report is being prepared. In the case of airspace management, a contract has been let to develop an automated low flying flight planning enquiry and notification system – ALFENS.

Mr Llwyd: To ask the Secretary of State for Defence if he will make a statement on progress in implementing the recommendations of the final report of the NATO CCMS pilot study of aircraft noise in a modern society.

Mr Hanley: The NATO CCMS pilot study on aircraft noise was completed in 1989. A follow-up group was created the following year to implement its technical recommendations.

This group exchanges information between participating countries and encourages individual or multinational studies. The United Kingdom contributed to a major symposium on helicopter noise, sponsored by NATO CCMS and held in the USA, and is currently participating in collaborative working parties engaged in noise modelling around airports and in the investigation and modelling of helicopter noise.

Extracts provided by Rupert Taylor FIOA

Book Review

Modern Methods in Analytical Acoustics by D G Crighton, A P Dowling, J E Ffowcs Williams, M Heckl and F G Leppington. Published by Springer-Verlag, 1992, softback, 738 pp, price £30, ISBN 3540 197 370

There must be many readers with a primarily practical engineering training who, like myself, are active in acoustics research and are frequently frustrated in their attempts to follow expositions of modern theoretical developments by insufficient familiarity with the mathematical techniques employed. Resort to mathematics books more often than not increases the frustration because of the difficulty of extracting from the labyrinth of Lemmas and clutter of Corollaries the relevant material.

Fear not - help is at hand! In this bulky volume, a quintet of eminent authors, for whom the theoretical modelling and analysis of things acoustic and unsteadily fluid dynamic is meat and drink, share with the reader the tricks of their trade.

The book is arranged in three parts. Part 1, entitled 'The Classical Techniques of Wave Analysis', provides an excellent review of the mathematical definitions, concepts, terminology, equations, relationships and procedures which are central to the subject, together with examples of application to elementary problems which allow the reader to get a feel for the way in which these powerful tools can be used (plus warnings of pitfalls for the unwary). This part also includes introductions to spectral estimation methods, SEA, Hamilton's principle, energy flux in sound fields and vibrating structures and a review of Numerical Methods including FEM, BEM and equivalent source techniques.

Part 2 comprises seven chapters under the general title 'The Generation of Unsteady Fields' which provides a feast of examples of the use of mathematical models to identify the mechanisms by which sound is generated by turbulence, vortices, propellers, thermoacoustic sources and rigid and flexible surfaces in contact with unsteady flow; the power of these models, when informed by physical insight, and manipulated by virtuosos, to provide understanding of the influence of the system parameters on sound generation is impressive indeed. This part also includes a chapter concerning fluid loading effects on structures.

Part 3 is entitled Wave Modification. It covers scattering and diffraction, inverse scattering, resonators, bubbles, reverberation, solitons, nonlinear acoustics, chaotic dynamics and anti-sound. It is invidious to select from this cornucopia of delights, but for me the most fascinating were the chapters on solitons and chaos, whereas the most instructive was that on nonlinear acoustics.

The material presented in this book has been developed in the form of lecture courses over a period of many years - and it shows: the authors clearly display their enthusiasm for their subjects and the presentation is essentially didactic; the expositions are, in general, concise, clear and firmly focussed; examples of applications abound and physical interpretation is not neglected. The references are up to date and well selected, except for a disappointing absence of references on Anti-sound. The fact that this book (sub-titled 'Lecture Notes') reads like a book and not a collection of disparate lecture notes, speaks well of the editor's skill. I learnt a lot and, in accordance with the hope expressed in the preface, I found it fun. So would you.

F J Fahy FIOA ❖

New Products

MANDOVAL COATINGS

Audex Acoustic Coatings

Audex Acoustic Coatings, consisting of a backing coat applied in a series of passes and a coloured finishing coat, provide a high degree of sound absorption across the entire frequency range. The material's attractive textured cosmetic appearance and colour range make it suitable for use in modern, historic, or futuristic buildings. Audex has been designed into buildings as diverse as conference centres, concert halls, sports centres, shopping malls, office reception areas and court buildings.

Audex G is formulated to produce an unbroken textured interior finish for ceilings and upper walls.

Audex P is able to accept a higher degree of impact and is therefore suited for use on the lower parts of walls, as well as semi-exposed locations, such as canopies, balconies and pedestrian tunnels. It is also suitable for internal ceilings and upper parts of walls likely to be subjected to high or fluctuating humidity.

For more details contact: Mandoval Coatings Limited, Mark House, The Square, Lightwater, Surrey GU18 5SS. Tel: 0276 471617. Fax: 0276 476910.

Mandoval Coatings Limited is a Sponsor Member of the Institute

SALEX ACOUSTIC MATERIALS

Mufti-Lag Hygiena Acoustic Lagging

Mufti-Lag Hygiena is the latest in a range of duct lagging materials from Salex Acoustic Materials Ltd (SAM). It has been designed specifically sensitive areas where traditional fibrous materials are deemed unacceptable, for example in environments such as data processing, and the food and drink, or pharmaceutical industries.

Mufti-lag Hygiena replaces the glass fibre traditionally used in duct lagging materials with a lightweight, flexible foam. It is lead free, with a low toxicity. Moulded from Class 0 materials, the product has a low thermal conductivity, and is able to operate within a wide temperature range. It is available in two barrier densities and three foam thicknesses to suit the widest possible range of specifications and applications.

Technical data sheet, sample and full details are available from:- Salex Acoustic Materials Ltd, Crown Gate, Wyncolls Road, Severalls Industrial Park, Colchester, CO4 4HT. Tel: 0206 852525 Fax: 0206 854445.

Salex Group is a Sponsor Member of the Institute

TELOG (UK) LTD

AcoustiCone

The AcoustiCone is a noise reduction product from Bruel Acoustics A/S and sold in the UK by TELOG (UK) Ltd. The AcoustiCone is a cone shaped sound absorber with a diameter of 82cm, consisting of pre-slit aluminium sectors held together by steel clips and interlined with mineral wool pads. The sound absorption is created by flow resistance through the small slits in the sectors.

The AcoustiCone can be wiped and it is not inflammable. Mineral wool pads, approximately 12mm thick, are placed inside the AcoustiCone and are delivered ready cut. The assembly and mounting fittings are rust resistant.

Further details are available from Telog (UK) Ltd, PO Box 18, Skelton, Saltburn-by-Sea, Cleveland, TS12 2XL. Tel: 0642 471777 Fax: 0287 77922.

CEL INSTRUMENTS LTD

Sound Level Analysers

CEL have announced a new range of sound level analysers based on two main models; the CEL-573 and CEL-593. Both are available in three versions - without frequency analysis (A version), with octave band (B version) or with both octave and 1/3 octave band functions (C version). Additionally all the models are available as Type 1 or Type 2 instruments. The CEL-573 provides a range of functions operating in real-time which can be controlled using the instruments clock facility.

Menu driven software provides easy access to the instruments' functions that include the simultaneous measurement of two parameters selected from any combination of frequency measurements, time constants or Q values.

The CEL-593 is equipped with all the functions found in the CEL-573 but also provides event and profile measurement modes used in environmental assessments like aircraft overflight and traffic noise.

Further information is available from Lucas CEL Instruments Ltd, 35-37 Bury Mead Road, Hitchin, Herts. SG5 1RT Tel: 0462 422411 Fax: 0462 422511.

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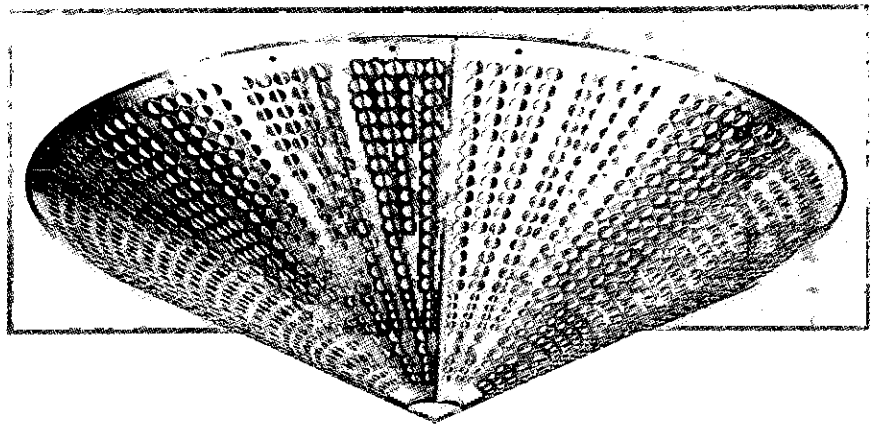


The AcoustiCone

LIVINGSTON HIRE

B&K Sound Level Meter Type 2236E

The first of Bruel & Kjær's new Type 2236E sound level meters to come off the production line are available for rental from Livingston Hire.

The versatile Type 2236E provides facilities for a quick assessment of noise levels. It can also act as a low-cost front-end for tape-recorders, transferring signals via an unweighted, calibrated AC output for spectrum analysis or subjective evaluation.

Designed specifically for the UK, the Type 2236E has built-in standard national and international parameters for all environmental and industrial noise measurement tasks. For example it provides Leq, SEL, MaxP and user-definable LN percentile levels for environmental noise measurement, and LEP,d and Peak measurements in parallel for industrial noise measurement, as required by the EC directive on exposure to noise at work (86/188/EEC).

For information contact Graham Harris, Livingston Hire, Livingston House, Queens Road, Teddington, Middlesex TW11 0LR. Tel: 081 943 5151 Fax: 081 977 6431.

NOISE CANCELLATION TECHNOLOGIES

Noise Cancelling Headsets

The NB-DX headset was introduced by Noise Cancellation Technologies, Inc. last year in New York. The headset uses NCT's active noise cancellation technology to reduce a noises such as those from lawnmowers, strimmers, and vacuum cleaners, as well as engine related noises from cars, trucks, tractors, buses, railway trains and aircraft.

The NB-DX is a lightweight, open backed headset (similar to but more sophisticated than, that used with a personal audio cassette player), with a 2.8" x 3.3" x 1.1" active controller, powered by a 9 volt battery. The controller can be clipped to the user's clothing or belt.

The NB-DX is claimed to reduce noise by up to 10 dB.

For further details please contact NCT's UK Representative: Don Fordy Ltd., 7 Orchard Grove, Penllergaer, Swansea SA4 1AD. Tel: 0792 895435 Fax: 0792 891235.

STRAMIT INDUSTRIES

SpeedDeck SoundRoof

Two SpeedDeck SoundRoof constructions (Rw=37/42 dB) have been created to satisfy the growing demand from designers for a lightweight roof that provides an enhanced and demonstrable acoustic performance. SpeedDeck SoundRoof is a practical system employing the established SpeedDeck profile suitable for actual pitches over 1°. This is combined with sound absorbent rock fibre insulation and a walkable perforated liner to create an acoustically efficient and economic construction.

For further information contact Stramit Industries Ltd, Yaxley, Eye, Suffolk. IP23 8BW. Tel: 0379 783465. Fax: 0379 783659.

News Items

EMCO

Appointment

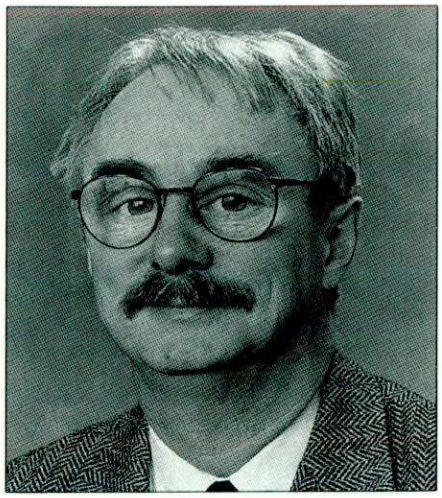
Following the recent promotion of Maurice Parsons from Manager to Director of the Industrial Division, EMCO ACOUSTICS have recently appointed Andrew Kern Divisional Sales Engineer.

Having spent the last 6 years working in the field of industrial noise control, Andrew has considerable experience of product design and sales within the Printing, Paper, and Board industries as well as a working knowledge of noise control applications throughout industry and it is expected that the appointment will assist in broadening the company's range of products and compliment those on offer from our building services division.

Brüel & Kjær

Distributor appointed

Brüel & Kjær has appointed Sound Advice as distributor in the North of



England for its industrial noise monitoring instrumentation. Selling through distribution channels is a departure for B&K and a strategic move to maximise sales into the occupational health and safety market.

Sound Advice is a recent start-up with John Houldsworth, one time sales engineer for B&K in the North West, at the helm. First products available from Sound Advice include B&K's Type 4436 dosemeter and the recently released occupational sound level meter Type 2236.

For further information contact Andrew Small, Brüel & Kjær (UK) Ltd, 92 Uxbridge Road, Harrow HA3 6BZ. Tel: 081 954 2366. Fax: 081 954 9504, or John Holdsworth, Sound Advice, 19 Preston Road, Lytham St Annes, Lancs FY8 5BL. Tel: 0253 796267.

AcSoft

New distributor for 01dB products

The French company 01dB, dealing in computer-based acoustic measurements, has appointed a new distributor in the UK. From 1st January 1994 AcSoft, a new company specialising in PC – based measurement systems, will be handling the advanced ARIA systems and configuring solutions to customers requirements.

Cirrus Research, who has been acting on behalf of 01dB since that company's formation in 1988, will continue to cooperate with 01dB on new technology and their software will remain data-compatible. AcSoft is headed by John Shelton, previ-

ously UK Sales Manager for Brüel & Kjær. Further information from John Shelton, AcSoft Ltd, 6 Church Lane, Cheddington, Leighton Buzzard, LU7 0RU. Tel: 0296 662 852, Fax: 0296 661 400.

Dassault Systèmes

Development agreement

In separate announcements in Chicago, USA and Victoria, Australia, on November 8th 1993, Dassault Systèmes of France described their CAA development agreements with Mentor Graphics (Chicago) and Moldflow (Victoria). CAA (CATIA Application Architecture), a registered trade mark of Dassault, provides manufacturers and service companies with the software development tools and methods required to create industry–specific applications based on CATIA open architecture.

Mentor Graphics is an Electronic Design Automation (EDA) tool supplier and Moldflow develops and markets computer aided engineering software for the plastic injection moulding industry. Dassault Systèmes is a subsidiary of Dassault Aviation and its products, CATIA and CADAM, marketed by IBM, are designed to support customer efforts, to reduce time–to–market, improve quality and optimise efficiency.

For further information contact Martine Vesco, Dassault Systèmes, 24–28 avenue du Général de Gaulle, 92150 Suresnes. Tel: (33) 1 40 99 42 18. Fax: (33) 1 42 04 45 81.

CEL Instruments

Portable monitoring kit

Local Authority Environmental Health Departments are known to be devoting an increasing proportion of their scarce resources to dealing with domestic noise complaints.

East Herts Council believe they have found one method of reducing the pressure on their noise specialists.

Householders in East Herts who are experiencing persistent noise problems could now be offered a portable monitoring kit which they can operate themselves.

The kit includes a sound level meter, which measures the noise level and records the time it occurred, and a Digital Audio Tape (DAT) recorder that can record the signal and be played back to identify the source.

As the sound level meter stores the results, the information can be recovered at a later date to produce documentation which may be offered in support of any legal proceedings.

The system will also operate automatically if a set sound level is exceeded which makes it suitable for intermittent noise 'events' like aircraft overflights as well as road and rail traffic movements.

Information on CEL environmental products can be obtained from: CEL Instruments Ltd, 35-37 Bury Mead Road, Hitchin, Herts SG5 1RT Tel: 0462 422411 Fax: 0462 422511

CEL Instruments is a Key Sponsor of the Institute.

Items for the New Products section should be sent to John Sargent MIOA at BRE. ❖

Noise and Vibration Specialist

for the high speed rail link from the Channel Tunnel to London

Union Railways is a wholly owned agency company of the British Railways Board, responsible for developing the high speed link from the Channel Tunnel to London. As the main rail link between Britain and the Continent, this is one of the largest construction projects ever undertaken in Europe and of fundamental national significance, particularly in Kent and the South East.

Noise and vibration effects arising from the high speed rail link are a key issue in the continuing development of the line and in the environmental assessment currently in hand.

Union Railways has commissioned the development of models to predict the effects of both noise and vibration and these are at various stages of refinement and validation.

Applications are invited from noise and vibration specialists interested in contributing to the further development of the high speed rail link and in the presentation of noise and vibration issues at various levels of the project.

Experience of prediction and calculation methodologies in respect of noise and vibration would be an advantage. The ability to contribute fully within a multi-disciplinary team is essential.

Please send a CV in confidence to Tim Rosbrook, Personnel Manager, Union Railways Limited, Network Technical Centre, Wellesley Grove, Croydon CR9 1DY. Closing date for applications is 18 February 1994.

union RAILWAYS

Aircraft Noise Specialist

Chief Scientist's Division

The Chief Scientist's Division of the National Air Traffic Services (NATS) is responsible for all research activities supporting the technical and operational development of air traffic control in the UK.

The CAA's Airport Noise Section is concerned with the effects of aircraft noise in the vicinity of airports and means for its alleviation. The new team member will be involved in the design, planning and execution of experimental and analytical studies of noise and its effects, and will report to the Head of Section.

In addition to basic scientific/engineering qualifications, applicants should have several years experience in acoustics, mathematical modelling, statistical analysis, computing and instrumentation, and a keen interest in aviation. Experience in research and a good knowledge of subjective acoustics would be advantageous. An ability to prepare reports on technical issues which will be understood at all levels of management is essential.

The position is based in Central London but the appointee will be required to travel as necessary, in the UK and abroad, to collect data and to attend meetings and conferences. Starting salary will be dependent upon experience.

A no smoking policy is encouraged within the offices concerned.

To apply, send a copy of your current CV to: Sharon Challis, Civil Aviation Authority, Personnel NATS, Room T1221, CAA House, 45-59 Kingsway, London WC2B 6TE.

Closing date: March 31st 1994.

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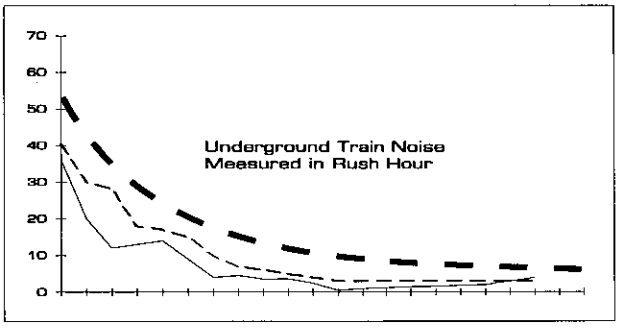

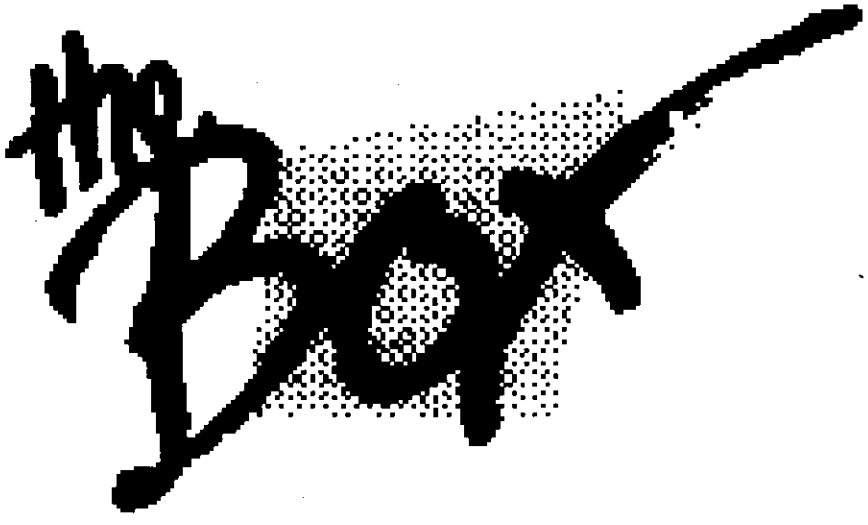

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