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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 two thousand 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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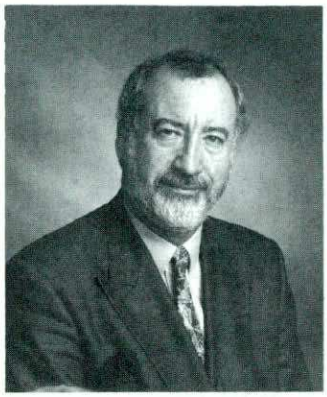


Dear Fellow Member

In my previous President's Letter, I drew attention to the note which had been issued by the Chief' Executive asking for your help in identifying potential new members. I am pleased to say that nearly 30 applications have been submitted as a result. This is a clear sign of the potential which exists in many organisations; I urge you all to encourage your non-member colleagues to apply.

Also on the membership front, I recently had a plea from an applicant in Brazil, for the Institute to make its forms available in electronic format. The Membership Committee are investigating the practicalities of such forms which would be available to all potential members via the Institute Web site.

In my very first President's letter, nearly two years ago, I referred to my strategic aims, a topic to which I will return in my final letter which is due to appear in the next issue. One aim was to increase our contact and involvement with overseas societies, not only throughout Europe but elsewhere. A gratifying example of such a contact occurred the other day when I received a letter from the President of the Acoustical Society of Peru, Dr Carlos Jimenez-Dianderas, in which he thanked the Institute and Dr Lawrence, Editor of the Bulletin, for the 'wonderful contribution the Bulletin had made to members of his society and to all those involved with acoustics in his country'. His comment on our Bulletin, which is the envy of many societies worldwide, only serves to confirm it as one of the most important benefits of Institute membership which I listed in the last issue.

I was also delighted to receive a letter from Dr David Weston FIOA, a former President of the Institute, who informs me that he is to be awarded the Acoustical Society of America's Helmholtz-Rayleigh Interdisciplinary Medal in Acoustical Oceanography and Underwater Acoustics. Our congratulations go to David, who is to receive this prestigious award at the June ICA/ASA meeting in Seattle.

Finally I note the rapid onset of Spring and with it the approach of the 1998 Spring Conference at Cranfield University, organised by the Institute and the Association of Noise Consultants which celebrates its 25th Anniversary this year. A fascinating programme, with international speakers has been assembled on all aspects of Transportation Noise. I look forward to seeing you there, and to presenting the Tyndall Medal to Jim Griffiths of Symonds Travers Morgan and Honorary Fellowships to Cathy Mackenzie and Professor Frank Fahy .

Sincerely yours

Bernard Berry

Bernard Berry

AN INTRODUCTION TO STATISTICAL ENERGY ANALYSIS

Frank Fahy FIOA

Introduction

Statistical Energy Analysis (SEA) is forty years old. Past reluctance on the part of industry to adopt this approach to analysing the vibroacoustic behaviour of complex structures is being overcome by the increasing availability of commercial software. This article presents a brief account of the origins, rationale and principles of SEA, mentions areas of current application and concludes with a brief survey of current research objectives.

Origins

The origins of SEA can be traced to the late 1950s when researchers familiar with the concepts and analysis of room acoustics took up the challenge of modelling audio-frequency structural vibration of complex structures such as ships and buildings. It took on rapidly increasing importance in the early 1960s as the 'space race' developed between the USSR and USA, because it provided an approach to estimating the response of launch vehicles, satellites and on-board systems to launch noise.

The problems presented by the geometric and material complexities of auditoria, together with the phenomena of scattering, diffraction and absorption, and the high density of acoustic modes, long ago persuaded acousticians to seek non-deterministic (probabilistic) representations of sound fields in large enclosed spaces. The two basic categories of room acoustic models are 'geometric' and 'energetic'. In the former, sources emit energy in the form of rays which are assumed to be reflected, scattered, and absorbed by the boundaries, and by the contents of an enclosure, to produce a non-uniform spatial distribution of energy: the probabilistic element lies in the modelling of the scattering process.

The latter is a global model in that the acoustic response of an enclosure is expressed in terms of the total stored sound energy; it yields no direct information about spatial distribution of response. Sources inject sound power into the enclosure and the probabilistic assumption that sound waves travel in all directions with equal probability and random phase in a 'diffuse' field allows expressions to be written for the total energy and the sound power incident upon any surface in terms of the spatial-average mean square sound pressure. The response estimate is obtained by equating the source sound power to the power absorbed by boundaries and contents. In addition to these basic models, much is known about the statistical properties of the acoustic response of enclosed spaces in the frequency and spatial domains.

In contrast to the majority of 'low frequency' vibration problems faced by engineers in relation to the malfunction, instability, failure and operational defects of structures such as rotational machinery, tall buildings and aeronautical and marine structures, vibroacoustic problems usually concern a frequency band stretching from a few tens to many thousands of Hertz, and involve a very large number of structural modes. Structural modes result from constructive interference between propagating vibrational waves which are reflected, refracted and scattered by numerous geometrically and dynamically complicated features such as joints, cut-outs, attachments, etc. Unlike the homogeneous isotropic medium of air, which can support only compressional waves, solid structures can support a number of different types of waves (principally bending, longitudinal and shear) which propagate through assemblages of components of various geometric form and material properties which may also be anisotropic. A variety of energy dissipation mechanisms operate in various parts of the system, largely at component interfaces. It is still not possible to model and predict structural damping with a high degree of confidence.

Given the generic similarity of the multi-mode problem, together with the additional uncertainties posed by structural complexity, it is not surprising that room acoustic modelling concepts inspired those concerned with attempts to develop practical approaches to vibroacoustic analysis at audio frequencies.

Rationale of SEA

In principle, it is possible to apply modern computer-based, discrete element methods such as the Finite Element (FEM) and Boundary Element (BEM) methods to all linear vibroacoustic problems. There are three main reasons why this is not at present practicable. First, the maximum acceptable linear dimension of each discrete element decreases with increase of frequency and the total number of degrees of freedom increases far more rapidly. For example, a finite element analysis of a two-metre-long section of aircraft fuselage, made in 1992, employed over half a million degrees of freedom to predict the natural frequencies and mode shapes up to 225 Hz. Second, responses have to be computed frequency-by-frequency over the required range, the interval depending upon the degree of precision required. Taken together, these two requirements demand substantial model building effort (for example, three person-months for a large ship), and long run times on powerful computer systems. These demands could be justified if the resulting predictions were reliable within the criterion of precision appropriate to the objective of the analysis. However, it is a well established fact that modal fre-

quencies and mode shapes are increasingly sensitive to small geometric and material details as the mode order increases, particularly in relation to the dynamic behaviour of connections between structural components. Uncertainty about the precise properties of complex assemblages in these respects, and also, in respect of damping mechanisms and spatial distribution, implies an unavoidable and uncertain discrepancy between a mathematical model and the physical system it represents. Consequently, the apparent precision of response predictions based upon large, deterministic models is illusory, particularly in relation to any one frequency and any single point on a system. It is generally acknowledged that their reliability is doubtful above the frequency of the tenth to twentieth mode. In the case of a passenger car body shell this will be between about 100 and 150 Hz.

A further reason for seeking an alternative, less labour- and computer-intensive model is that any set of nominally identical, mass produced artefacts exhibits a considerable, and ultimately irreducible, variation of frequency response, of which an example is shown in Figure 1. Although the variations are greatly decreased by integration over finite frequency bands, such as one-third octaves, the inherent variability suggests that models which produce estimates of population response statistics are more appropriate to the task. The laws of physics demand that the ensemble average response is dictated by gross parameters of a system (eg material thickness, overall dimensions, material type); but the details govern the variance. In principle, stochastic (randomized parameter) Finite Element models could generate such statistical response data, but the appropriate selection of 'variable' parameters and the choice of associated parameter population statistics is currently very problematic.

These considerations all point to the adoption of an inherently probabilistic model together with a selection of response variables which are global and not local and which are estimated directly in the frequency bands of interest. SEA fits this bill.

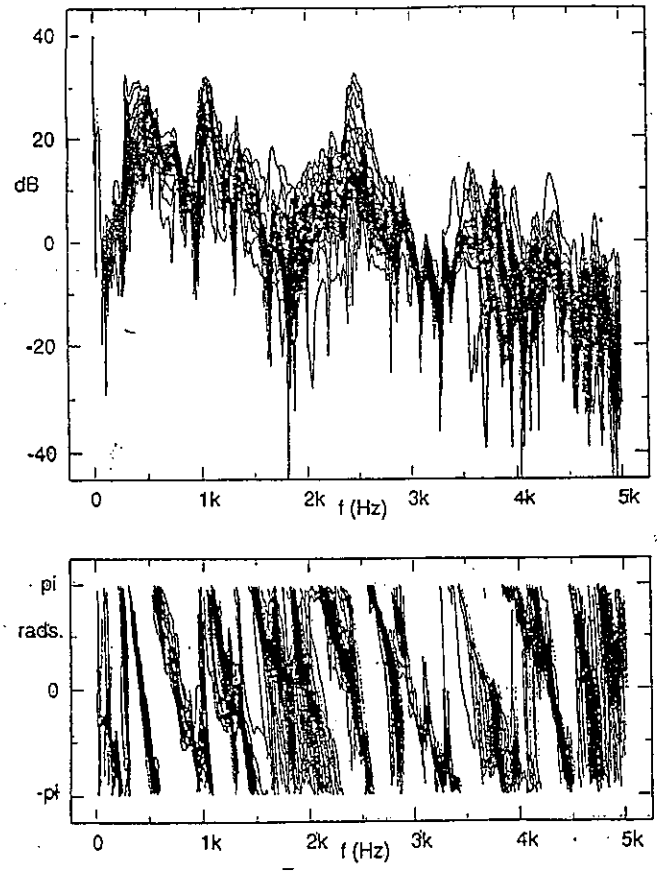


Fig. 1. Vibroacoustic responses of 41 nominally identical beer cans

The Principle of SEA

SEA is based upon the postulate that a reverberant vibrational (or acoustic) field, generated in a 'subsystem' which forms part of a larger system, transmits vibrational energy into connected 'subsystems' at a rate proportional to its time-averaged, stored energy (potential plus kinetic). This postulate is supported by many theoretical and experimental studies, a selection of which are cited in the publications listed in the bibliography at the end of this article. The criteria for the definition of a suitable set of subsystems are not, at present, formally established, but an *ad hoc* recommendation is that subsystem boundaries are defined to coincide with points, lines or surfaces at which incident vibrational waves are rather strongly reflected by features which present large impedance changes to the oncoming waves. Examples include connections between plates of significantly different thickness or right-angle connections between beams or plates. This condition favours the establishment of multiply-reflected, reverberant wave fields within each subsystem, provided that its damping is not too high. It also means that it is physically meaningful to employ the concept of 'subsystem modes' or 'local modes' which resemble those of the uncoupled subsystem.

The SEA Equations

The fundamental SEA relation between stored and transferred energy is not valid unless the excitation bandwidth encompasses at least one uncoupled mode resonance frequency in each coupled subsystem: thus single frequency or narrow band excitation cannot be accommodated, unless frequency response statistics are available. It is customary to assume that a system under consideration is subject to multi-frequency excitation, of which the bandwidth is sufficiently large to encompass at least five uncoupled mode resonance frequencies.

The actions of external excitation mechanisms to which a system is sub-

jected are represented by time-averaged power inputs to the appropriate subsystems; the actions of dissipative processes are represented by time-averaged power losses; and the subsystem coupling actions are represented by time-averaged power exchanges. On this basis, power balance equations are written for each subsystem, as indicated in Figure 2. It is seen that an SEA model is essentially an energy diffusion model.

Theory shows that the fundamental proportionality relation between stored energy and energy transfer may be expressed in terms of a difference between average energies per mode (modal energy) of coupled subsystems. This is expressed by *Equation 1*, for a two-subsystem model, in which E_i represents the stored energy of subsystem i, n_i is the subsystem modal density (the inverse of the average separation between modal natural frequencies), η_i is the damping loss factor, P_i represents external power input and η_{ij} is known as the 'coupling loss factor' between subsystems i and j.

$$P_{ij} = \eta_{ij}\,\omega\, n_i\,[E_i/n_i - E_j/n_j] \qquad (1)$$

By analogy with the heat conductivity equation, E/n and the factor $\eta\omega n$ may be thought of as subsystem temperature and conductivity coefficient, respectively. Energy flows from 'hotter' to 'cooler' subsystems. An approximate hydraulic analogy is shown in Figure 3.

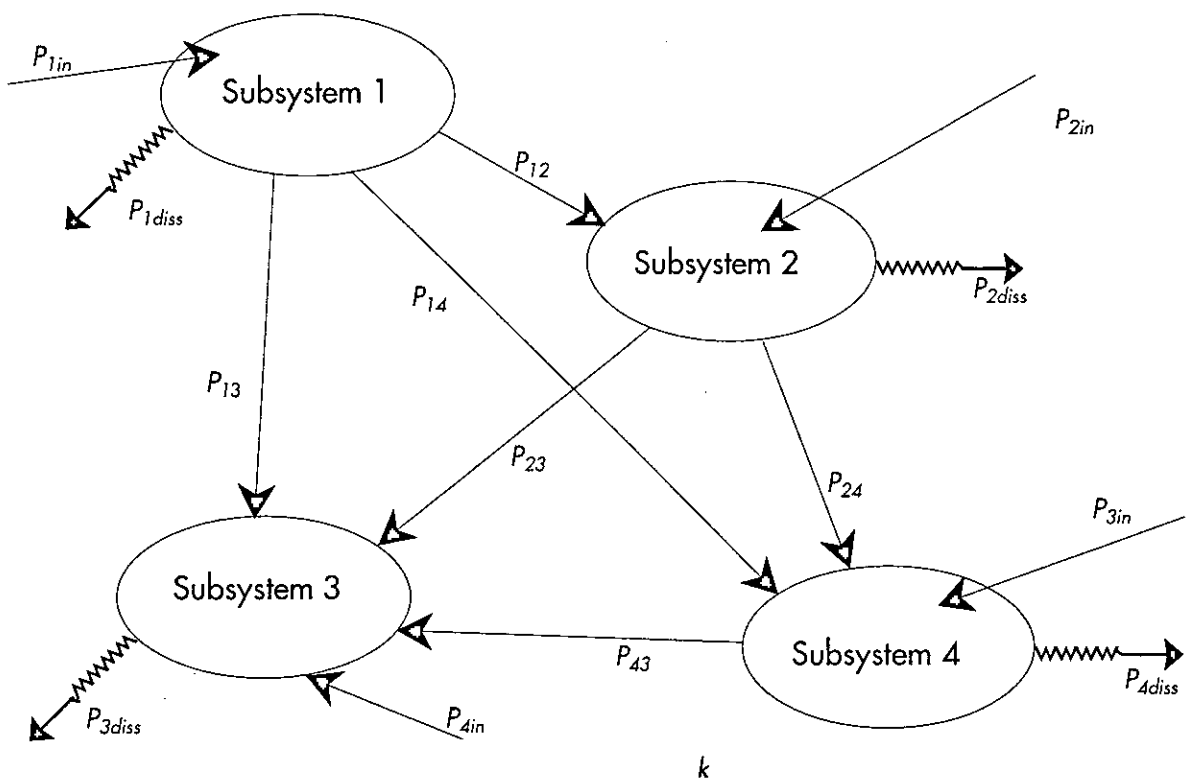
Solving the SEA Equations

Once the input powers, loss factors and modal densities are defined, the set of power balance equations may be solved for the subsystem energies. The damping loss factors are normally assumed on the basis of empirical data. The main challenge is to estimate the coupling loss factors. These are proportional to the wave intensity transmission coefficients which define the proportion of incident wave energy that is transmitted across subsystem connections.

The concept of such coefficients will not be new to those who deal with airborne sound transmission losses and acoustic absorption by surfaces. Coupling loss factors are either calculated from analytical or finite element models of wave transmission through connections or determined by experiment on existing systems. The latter procedure involves the injection of vibrational power into each selected subsystem of a physical assemblage in sequence. Mean square vibration velocities (or sound pressures) are measured at a number of points on each subsystem in order to estimate subsystem energies; the resulting power balance matrix equation is subsequently inverted to obtain the coupling loss factors. This is called the 'power injection method'. Modal densities are usually estimated theoretically.

Why 'Statistical'?

The 'EA' of 'SEA' has been discussed: but what about the S? In principle, SEA models the ensemble-average vibrational behaviour of a population of grossly similar systems, having influential parameters vibration drawn from a random set. The statistical aspect of SEA is not generally explicit, except in research studies. The prob-



$$\text{Power Balance } P_{iin} - P_{idiss} = \sum_{j \neq i}^{k} P_{ij}$$

Fig. 2. SEA Subsystem Power Balance

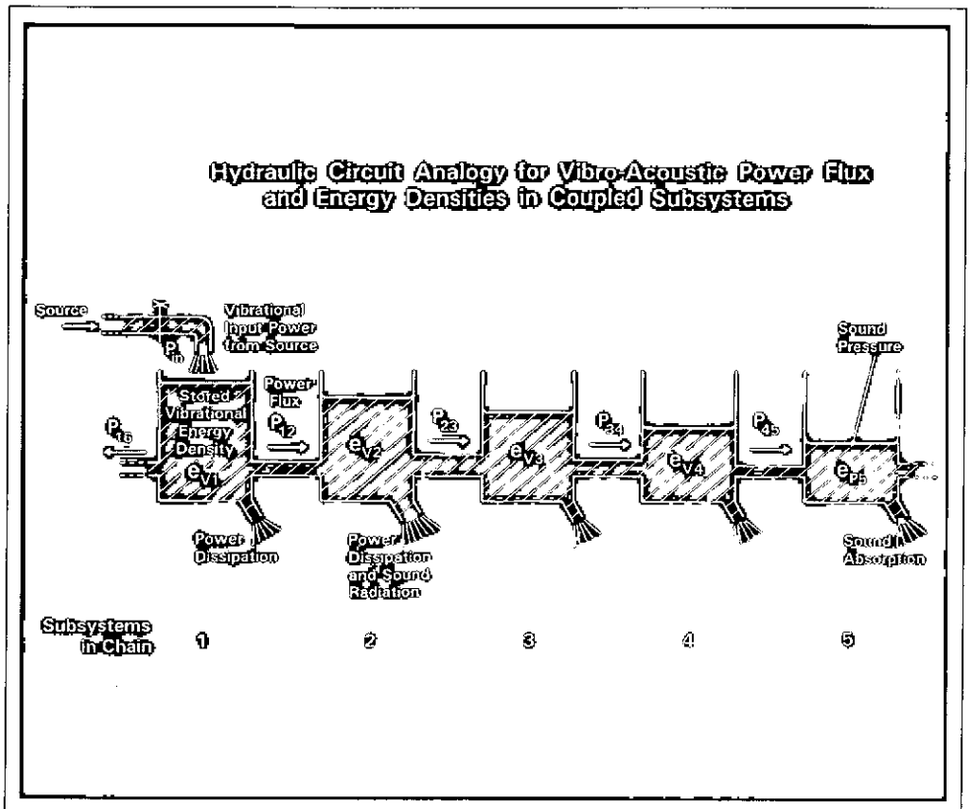


Fig. 3. A hydraulic circuit analogy for SEA

lem presented to deterministic approaches to modelling the vibrational behaviour of systems at audio frequencies has been explained. The essentially probabilistic nature of SEA models is concealed in the assumption central to theoretical representation of the subsystem wave fields as being diffuse (or alternatively that many modes contribute to the field in a frequency band and that the modes are mutually uncorrelated). In calculating the wave intensity transmission coefficients, it is assumed that the waves leaving and returning to each junction after reflection from other subsystem boundaries are also mutually uncorrelated. The concept of modal density is also statistically based. Therefore, an SEA model does not represent any one archetypal system: it represents the average behaviour of a population of grossly similar systems of which the details differ in a deterministically unknown, but statistically describable, manner. The robustness of SEA derives from its use of total subsystem energy evaluated in finite frequency bands containing many modal resonance frequencies, which is far less sensitive to small physical perturbations than single-frequency responses at an individual point. Probabilistic wavefield modelling greatly reduces the effort of evaluating subsystem coupling, via the wave transmission coefficient. The use of total energy as a response variable reduces the number of degrees of freedom from the tens or hundreds of thousands typically required by FEM or BEM to the number of subsystems, which would typically number about fifty for a passenger car body.

Applications of SEA

Those who measure transmission losses of partitions between two rooms or reverberation chambers are essentially applying a simplified form of SEA. The sound fields are assumed to be reverberant and diffuse, and the incident intensity is determined from the mean square pressure estimate in the source room on the basis of diffuse field theory. Sound energy is transmitted through the partition at a rate proportional to the acoustic energy stored in the source room. The dissipation loss factor of the receiving room is inversely proportional to the reverberation time. The simplification is implicit in the neglect of energy returning from the receiving room to the source room, although its loss from the receiving room is accounted for if the reverberation time is measured with the partition in place. The 'error' is very small unless the transmission loss of the partition is less than about 5 dB. Interestingly, Eyring analysed the sound energy decay behaviour of two coupled rooms in the 1930s, essentially using an SEA model, albeit in a transient state.

SEA has been applied to a vast range of vibroacoustic problems including estimates of interior noise in land, sea and airborne vehicles and offshore installations, spacecraft launch studies, building acoustics, machinery and plant noise predictions and in estimates of the vibrational response of pipelines and nuclear reactors. Some areas of application are illustrated in Figure 4.

It offers many advantages over large deterministic model analyses, especially at the early stages of design when rapid parametric sensitivity studies are required to establish feasible candidates for the job. It allows the user to retain a 'feel' for the physics of a problem and the reasons for the effects of parametric modifications. Response estimates are subject to the constraints imposed by energy conservation and are maximally limited by the

PPG 24 – PLANNING AND NOISE

Rupert Thornely-Taylor FIOA

Introduction

In 1996, the then Department of the Environment awarded a research contract to the author to review the technical application of PPG 24, the Government's Planning Policy Guidance PLANNING AND NOISE, and to identify any requirements for additional guidance. (It was not intended to make any changes to policies and principles contained in the PPG.) This article summarises the work undertaken, and the findings.

The objectives of the work were to study the application of PPG 24; to identify any requirements for additional guidance; to make recommendations as to needs and priorities for additional guidance to assist in the application of PPG 24; and to provide an indication of possible methods that could be developed and then adopted in the guidance. The issue of further actual guidance is of course a matter for government and is outside the scope of this article which contains solely the views of the author and not necessarily those of the Department of the Environment, Transport and the Regions (the DETR).

Much of the analysis of PPG 24 presented here consists of the results of a careful study of the guidance, and is presented in an attempt to make the existing guidance clearer to practitioners in the field. Where recommendations on additional guidance are made, these remain no more than recommendations.

The Existing Guidance

The guidance given in PPG 24 can be summarised as follows. The first priority is separation of noise sources and noise receivers. Mitigation is the second priority, where separation is not possible. Local authorities must take the content of Planning Policy Guidance notes into account in preparing their development plans. Plans should contain policies to separate noise sensitive development from existing noise sources and noise-emitting development from noise-sensitive areas. Policies to protect tranquil areas may be appropriate. In consideration of applications for residential development near transport-related noise sources Noise Exposure Categories should be used. Development control should ensure that development does not cause an unacceptable degree of disturbance. Noise-sensitive development should not normally be permitted in areas which are, or are expected to become, subject to unacceptably high levels of noise. Where separation of land uses is impossible, noise should be controlled or mitigated through the use of planning conditions or planning obligations. The effect of noise on designated areas and the countryside should be considered. Further guidance is provided to elaborate upon the policy guidance, and to provide, in some cases, numerical and other technical means of determining whether the policy criteria are met. The principle numerical guidance relates to the determination of Noise Exposure Categories (NECs). In Category A, noise need not be considered as a determining factor in granting planning permission, although the noise level at the high end of the category should not be regarded as a desirable level. In Category B, noise should be taken into account when determining planning applications, and, where appropriate, conditions imposed to ensure an adequate level of protection against noise. In Category C, planning permission should not normally be granted. Where it is considered that permission should be given, for example because there are no alternative quieter sites available, conditions should be imposed to ensure a commensurate level of protection against noise. In Category D, planning permission should normally be refused. Recommended boundaries for the NECs are given in terms of L_{Aeq} for day and night according to type of noise source, (see Table 1 below).

For residential development exposed to noise dominated by an industrial source the recommended method of determining noise acceptability is to use the guidance in BS 4142 [2]. However, this standard offers no test of acceptability *per se*. PPG 24 indicates that likelihood of complaints, which is to some extent predictable using BS 4142, should be the basis of acceptability.

For the assessment of noise from non-industrial and non-transportation sources, no guidance is given on the quantification of acceptability.

The Study

All planning authorities in England, of which there are just under four hundred, were consulted. A wide range

noise source		noise exposure category A	B	C	D
road traffic	(07.00–23.00)	<55	55–63	63–72	>72
	(23.00–07.00)	<45	45–57	57–66	>66
rail traffic	(07.00–23.00)	<55	55–66	66–74	>74
	(23.00–07.00)	<45	45–59	59–66	>66
air traffic	(07.00–23.00)	<57	57–66	66–72	>72
	(23.00–07.00)	<48	48–57	57–66	>66
mixed sources	(07.00–23.00)	<55	55–63	63–72	>72
	(23.00–07.00)	<45	45–57	57–66	>66

Table 1 Recommended noise exposure categories, $L_{Aeq,T}$, dB

Note: Sites where individual noise events regularly exceed 82 dB L_{Amax} (S time weighting) several times in any hour should be treated as being in NEC C, regardless of the $L_{Aeq\ 8h}$ (except where $L_{Aeq\ 8h}$ already puts the site in NEC D).

of other organisations were also consulted and five workshops were held. Approximately 40% of the local authorities replied. Of these, seven have policies exactly based on the PPG 24 Noise Exposure Categories. Fourteen local authorities have taken or expressed an intention to take PPG 24 into account in review of their plans. Several authorities are acting together to provide guidelines for use in their areas. Twenty-six authorities reported no policies on noise, no planning appeals or inquiries giving rise to unresolved noise issues, and had no difficulties or other views on PPG 24.

A study was made of planning appeals decided by inspectors or by the Secretary of State for the Environment in which reference was made to PPG 24. A total of twenty reports and decision letters were considered.

The consultation responses and the workshops discussions raised a large number of points. These can be summarised as: shortage of resources; uncertainties over measurement and prediction of noise levels; lack of consideration of amenity as a concept; needs for further guidance on noisy development both involving commercial/industrial and a wide range of other sources; lack of advice about preventing creeping ambient; difficulties with Noise Exposure Categories; interaction with other orders, regulations and guidance and many other miscellaneous points.

Needs for Additional Guidance

Needs for additional guidance were identified in the following areas.

- There is a need for further guidance on a number of aspects of Noise Exposure Categories, including methods of establishing site noise levels whether by measurement or prediction, and to define whether an open site should be assumed or whether the built environment should be taken into account.
- There is a need to define the levels of noise protection which are required if residential development is permitted in categories B and C.
- There is a need to clarify whether references to 'industrial' development also include 'commercial' development.
- A wide range of circumstances were identified in which there is a need for further guidance, including cases of low background noise level, aerodromes with low movement numbers and ground noise at airports.
- The need for a number of corrections was identified.
- There is a need to clarify the status of model conditions in the light of Circular 11/95 and to provide further guidance on conditions which implement the PPG's advice about the need for 'adequate' and 'commensurate' protection.
- There is a need to consider how to take account of changing guidance from the World Health Organisation.

Some of the detailed issues associated with these needs for additional guidance are discussed below.

Noise Exposure Categories

It became quite clear in the study that the PPG's advice about Noise Exposure Categories is being widely interpreted, by local authorities, developers, planning inspectors and others in two conflicting ways. In some cases, sites are assessed as open sites without taking account of noise mitigating features such as noise screens or of the built form on the finally developed site. Developers have come forward with schemes in which, by a variety of means, they achieve noise levels at façades which place the development in a lower category than would be the case for an open site. There have been cases put by developers that they need only evaluate the noise level at ground level (eg 1.2 to 1.5 m above ground), when clearly at higher levels, such as first floor and above, the effect of noise barriers may be substantially less. At the other extreme, local authorities have insisted that sites should be categorised as open sites, without allowing for noise barrier features, even going to the trouble of calculating the effect of an already existing noise barrier in order to remove the effect.

One of the tasks of development plans is to allocate land, and in allocating land for future housing development, when there can be a long delay between considering land for housing and development actually being completed, it is difficult to determine NECs if it is necessary to take account of the built form on the site, when only the broadest indication of the likely form that development might take may be available. By contrast, paragraph 8 advises that NECs are introduced to help local planning authorities in their consideration of applications for residential development near transport-related noise sources, in which case determination of NEC categories could, if necessary, take full account of all features to be built on the site.

Some assistance in resolving the apparent conflict is available if care is taken to read the specific technical guidance on NECs within the context of the overall guidance provided by the PPG. Paragraphs 2 and 12 of the PPG make it quite clear that the principal policy is to separate noise-sensitive development from noisy areas. Only when this is not possible is mitigation recommended (paragraph 2, last sentence).

Mitigation is defined in paragraph 13, and includes protection of noise-sensitive buildings (eg by improving sound insulation in these buildings and/or screening them by purpose-built barriers), screening by natural barriers, other buildings, or non-critical rooms in a building. In paragraph 17, advice is given on conditions. 'Where it is proposed to grant permission for noise-sensitive development in areas of high ambient noise, planning conditions should be imposed to ensure that the effects of noise are mitigated as far as possible. For example intervening buildings or structures (such as garages) may be designed to serve as noise barriers. In some cases sound insulation measures may be considered appropriate. (Such measures will mainly apply to windows: additional guidance is given in Annex 6.). However, it should be remembered that the sound level within a residential building is not the only consideration: most residents will also expect a reasonable degree of peaceful enjoyment of their gardens and adjacent amenity areas.'

Airport quality noise monitoring for community applications

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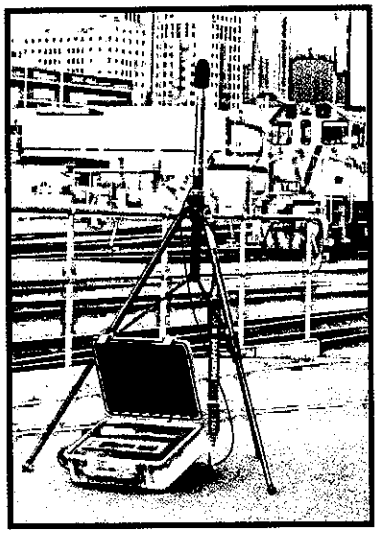

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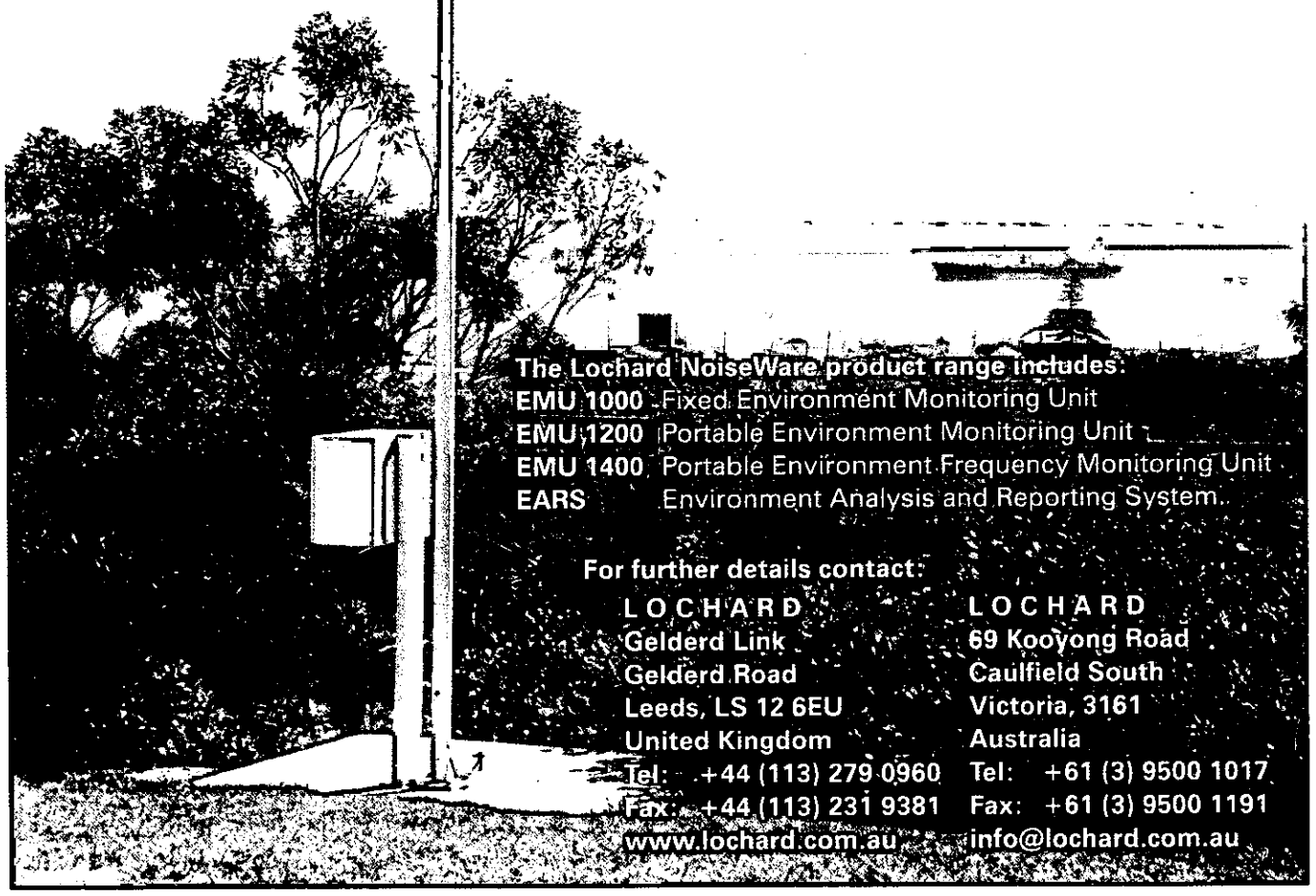

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Annex 1 advises that 'When assessing a proposal for residential development near a source of noise, local authorities should determine into which of the four noise exposure categories (NECs) the proposed site falls, taking account of both day and night-time levels. Local planning authorities should then have regard to the advice in the appropriate NEC.' The advice in NECs B and C refers to conditions being imposed when permission is given.

In summary, the position is: determine the *site* NEC, *then* consider conditions, and conditions include measures such as barriers which would actually reduce façade noise levels. There is no suggestion that having imposed the conditions, the resulting mitigation entails re-categorization to a less strict category.

If it were otherwise (and noise mitigation caused recategorization), logical absurdities would ensue. For example, if an open site exists, and noise levels on the site place it is category B, and a developer subsequently prepares a planning application assuming planning conditions requiring noise barriers along the road frontage which have the effect of reducing noise on the site by at least the amount by which the noise exceeded the threshold of category B, then the consequence of transferring the site from NEC B to NEC A would be to change the advice to 'Noise need not be considered as a determining factor in granting planning permission'. There would then be no need for a planning condition to ensure that the mitigation measures on which the transfer from category B to category A depended were included in the scheme.

If 'open site' assessment is the rule, however, how do you define 'open site'? Suppose the natural terrain of a site gave noise protection, for example because a road passing the site was in a cutting, such that the site was in category A, and a developer regrades the site, lowering the ground level and the noise barrier effect of the top of the cutting is reduced, which is the open site – the original ground topography or the regraded topography? To take out of a NEC computation the effect of a cutting, would be going too far.

The real test to determine whether or not topographical features on the site have the effect of changing the NEC category is whether the NEC is dependent on planning conditions. If façade noise levels, or noise levels in gardens, are low enough to shift a development from one NEC to another only as a result of including features in the development the presence of which has to be ensured by means of planning conditions, then the NEC category does not change.

Extending this logic leads to a potential difficulty if the development itself introduces a significant source of noise such as a road. Applying a consistent approach, its effect should not be taken into account in determining the NEC for the development, but mitigation against its effects should be considered as a matter for planning conditions or planning obligations.

A matter which requires clarification is whether the onus should be upon the planning authority to carry out the noise assessment of a planning application, or whether the authority can legitimately place the burden on the applicant.

Low background noise levels. There is repeated reference in the consultations to problems of areas with low background noise levels. Where this affects the applicability of BS 4142, the comments are clearly valid and the 1997 revision to BS 4142 provides some clarification. Some of the comments are made in the context of the use of Noise Exposure Categories, which are based on absolute environmental standards and the concept of their representing large increases in noise in areas of low background is illogical since with new housing development there is no pre-existing occupier to experience the increase, unless, contrary to PPG 24's advice, NECs are used in reverse. The argument against using NECs in reverse is not stated very strongly in the PPG, and indeed could be reinforced by adding the point that in areas of very low background noise, using NECs to gauge the impact of a new noise-emitting development could conceal a significant increase in noise for the pre-existing residents.

Use of NECs in reverse. The consultation responses indicated a significant demand for something akin to the use of NECs in reverse, or more clearly stated absolute standards or specific guidance on noise limits such as that given in MPG 11 [3]. PPG 24 appears to acknowledge the place of absolute standards for noise-emitting development, in its reference to BS 8233:1987 [4] in Annex 3 paragraph 19, and to the WHO guidelines [5] in Annex 2. However, a forensic reading of the documents could suggest that BS 8233 relates to standards for new buildings, and reference to WHO is made only in the context of NECs, which only apply to new buildings. Annex 5 Section 1, indicates the appropriateness of an absolute limit for noise from a new source, without giving explicit guidance on the selection of the numerical value of the limit.

Creeping ambient and absolute limits. The repeated concern expressed about the loss of the advice formerly given in Circular 10/73 [6] on prevention of the 'creeping ambient' is allied to the subject of absolute limits, since a creeping ambient becomes a problem when the ambient creeps above some point of unacceptability.

Given the fact that sources such as recommendations from the World Health Organisation obviously have status quite independently of PPG 24, and their recommendations are not restricted to new noise-sensitive development near existing sources, from transportation or otherwise, the introduction of absolute standards into planning arguments is inevitable, and PPG 24 ought perhaps to grasp the nettle.

Non-industrial noise-emitting development

The largest policy area in which guidance is lacking relates to noise-emitting development other than industrial noise, or industrial and commercial noise if paragraph 11 of the PPG is not interpreted strictly. The list of types of noise source faced by planning authorities is long and contains some surprising items. The prospects of being able to give detailed guidance on all of them

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are not good, but a possible approach to solving the problem progressively emerged in the course of the study, and is referred to below.

Possible Methods that Could Be Adopted in Further Guidance

With a view to fulfilling the needs for additional guidance identified, the following text passages give an outline of the type of advice that would deal with the issues raised.

Interpretation of NEC advice

There are two conventions in the presentation of environmental noise data, one of which takes account of the effect of the presence of building façades, the other does not (the results being known as 'free-field'). The values in Table 1 are free-field noise levels as would, for example be measured on a flat, open site at the position of the proposed dwellings, well away from any existing buildings. Many sites are neither flat nor open, and the question of whether or not site features, which cause noise levels to differ from those on an open site, should be taken into account must be considered in the following manner.

Predictions of noise should take account of the layout of the site ignoring any features whose presence in the completed development could be ensured only by planning condition or planning obligation. The effect of noise barriers, earth bunds, buildings which will exist on the site following completion and the nature of the ground surface should be taken into account only if they would exist in the absence of planning conditions or obligations. The purpose of the NEC system is to detect the need for such planning conditions or obligations and therefore their effect does not play a part in deciding the NEC into which an application site falls. Noise generated by parts of the development itself, such as access roads, should not affect the NEC categorization of the site, but should be taken into account in considering necessary mitigation measures.

The noise levels which are relevant to the determination of the Noise Exposure Category of a site affected by noise from roads or railways should be determined using the calculation procedures, where they are valid, required by the relevant Noise Insulation Regulations. Measurements are appropriate where those procedures provide for them. The results should be adjusted for consistency with the units and time periods used. For noise from roads to which the procedures of the Department of Transport publication 'Calculation of Road Traffic Noise' (CRTN) [7] are applicable, hourly traffic flow figures should be determined (taking those which would produce the highest noise levels based on predictions of traffic flows for 15 years after the proposed dwellings would be first occupied) and the hourly L_{A10} values calculated in accordance with Section I, paragraph 31.2 using Chart 2. The hourly values between 23.00 and 07.00, and between 07.00 and 23.00 should be averaged arithmetically and rounded to the nearest whole number of decibels (0.5 being rounded up). In circumstances where CRTN provides for measurement instead of prediction, hourly values may be measured according to Section III, and adjusted for the projected traffic flow figures. In such

cases L_{Aeq} values may be measured directly; in other cases, L_{Aeq} levels should be obtained from calculated L_{A10} levels by the subtraction of 3 dB from the final result.

For noise from railways where the Department of Transport publication 'Calculation of Railway Noise' (CRN) [8] is applicable, $L_{Aeq\ 0700-2300}$ $L_{Aeq\ 2300-0700}$ may be calculated directly using Stage 5 and substituting appropriate figures for numbers of trains in the period 23.00–07.00 in Q_{NIGHT} and in the period 07.00–23.00 in Q_{DAY}. The constants 43.3 and 48.1 should be changed to 44.6 for night and 47.6 for day. The rail traffic assumed should be that which would produce the highest noise levels within 15 years after occupation of the proposed dwellings.

On a flat, open site, the effect of height is largely limited to the effect of soft ground cover. On complex sites, perhaps affected by elevated transportation systems, or the effect of cuttings, noise levels may vary considerably with height. For aircraft noise, the effect of height is not normally relevant. The noise levels used for determining NECs should be determined for, or corrected (using the methods given in the CRTN or CRN) to, the height of the highest noise sensitive window in any building façade which could be built on the site.

For aircraft noise, noise contours prepared according to the method adopted by the Department of Transport should be used both as regards the technique used to predict the contours and the treatment of assumptions regarding runway usage. These should be based on air traffic forecasts such that would give the highest noise levels within 15 years after the proposed dwellings would be first occupied.

If part of a site falls in one category and part in another, the relevant parts of the site should be assigned Noise Exposure Categories individually.

In cases where noise from more than one transportation source affects a site under consideration care must be taken in combining the contributions of each source to the overall noise level.

The NEC boundaries, the derivation of which is explained in Annex 2, are largely based on (or traceable to) the effects of noise indoors and indoor noise levels are little affected by reflections from façades or the ground surface. For this reason, when combining noise levels from aircraft with noise from roads and railways, the effect of ground reflection which is included in aircraft noise contours (and deemed to be 2 dB) should be subtracted from the aircraft noise level before decibel (logarithmic) addition of the sources. If the combined level is 3 dB or more greater than the noise level of any individual source, the 'mixed sources' category limits should be used. Otherwise the road, rail or air traffic category limits for the source with the highest noise levels should be used. Although there are circumstances where different transportation noise sources may exist on opposite sides of a site, so that one building façade may not be affected by both together, the consequences of this possibility should be ignored.

If a proposed development site contains buildings to be demolished or significantly altered, the change in topography is not dependent on a planning condition or obligation, and a measurement method is used, care should be taken to correct the results for the proposed change in the layout and topography of the site, using correction methods in either CRTN or CRN as appropriate. No corrections for the presence of buildings should be made in the case of aircraft noise.

Where a dwelling falls exactly on the boundary between two categories, it should be placed in the higher of the two categories.

The NEC system is not primarily intended for dealing with industrial noise. Where a site is affected by noise from an industrial or commercial source, an assessment according to BS 4142:1997 should first be carried out. If the conclusion according to paragraph 8.2 of BS 4142:1997 is that complaints are likely, the proposed development should be placed in category D. If the conclusion is that the noise is of marginal significance, the proposed development should be placed in category C. In all other cases, the $L_{Aeq\ 0700-2300}$ and $L_{Aeq\ 2300-0700}$ values of the industrial noise (after adding a character correction as described in paragraph 7.2 of BS 4142) should be calculated and combined by decibel (logarithmic) addition with noise from transportation sources and allocated a NEC using the criteria for 'mixed sources', unless one of the transportation noise sources is dominant in which case the development should be assessed against the NEC criteria for that source. A noise source is dominant if its noise level, before combination with the noise of other sources, is not less than 2 dB below the combined noise level of all sources.

In considering the effect of planning conditions to make development acceptable in categories B or C, care should be taken, when carrying out a BS 4142 assessment, to allow for the lowering of background noise which may be a consequence of the inclusion of noise barriers to protect a housing scheme, and which may consequently increase the likelihood of complaints about an industrial/commercial noise source.

Possible widening of the NEC principle

Consideration should be given to the possibility of using NECs for other non-transportation noise sources if the local authority's assessment was that noise complaints would be likely in a particular area, for example an area around a well established recreational facility.

Railway vibration

New guidance is required on the subject of NECs and vibration and ground-borne noise from railways.

The L_{Amax} Test

Clarification of Note 1: 'Several' means more than twice in any one hour period. 'Regularly' means that it is predictable that events will occur according to a timetable or programme, eg trains in a timetable or delivery lorries which follow a predictable pattern, or where night time heavy vehicle flows on a road are high enough for several heavy vehicles to pass the site in one hour and give rise to individual noise events in excess of 82 dB $L_{Amax,\ S}$.

For aircraft noise and railway noise, an SEL value of 90 dB(A) may be used as the test instead of 82 dB

$L_{Amax,\,S}$, since these quantities may be obtained by standard prediction methods. New guidance is required to enable $L_{Amax,\,S}$ or SEL to be calculated for road vehicles.

In a High Court application under Section 288 of the Town and Country Planning Act 1990, clarification of the Lamax test was given [9]. In effect the judge said that 'several' means more than two. His logic was that fewer than three events an hour at 82 dB L_{Amax}, if continued throughout the night, could cause a $L_{Aeq\ 8h}$ which would place the site in category C anyway. He therefore deduced that the footnote must be construed as meaning more than two because 'if the footnote is to be construed as meaning that two events in a single hour would bring the site within that same category by virtue of the footnote, the regular events throughout the night, which are clearly much more disturbing than the events only during one hour of the night, would be an unnecessary basis for categorisation'.

Annex 3

Annex 3 should be split into two sections, one dealing with development affected by existing noise sources, the other dealing with noise emitting development.

Advice on the planning of new roads is required, ie by referring to the Design Manual for Roads and Bridges in a wider context than vibration.

Advice on the interaction between the content of PPG 24 and the requirements for Environmental Statements is required.

Noise-emitting development

The conclusions reached using BS 4142: 1997 may be used as a test of the acceptability of the degree of disturbance referred to in paragraph 10. A likelihood of complaints is an unacceptable degree of disturbance. In considering cases of marginal significance, regard should be had to general standards for noise levels inside dwellings set out in paragraph 8.1 of BS 8233: 1987 using values for the time period *T* consistent with those used in the BS 4142 assessment and including a character correction as described in paragraph 7.2 of BS 4142. If these are not exceeded, then marginal significance may be acceptable.

Where there is no foreseeable likelihood of subsequent noise-emitting development in the same area such that the overall noise level from industrial and commercial sources would be increased, permission should not be granted where the conclusion according to BS 4142 is that complaints are likely. In cases where there are several specific noise sources, or are likely to be in the future, regard should be had primarily to the likelihood of complaints using the formal procedures of BS 4142, and also to the absolute noise level.

It is undesirable that the overall free-field L_{Aeq} level should be increased as a result of new industrial or commercial development to a total external level of more than 55 dB 07.00–23.00 or 45 dB 23.00–07.00, or in cases where transportation noise sources give rise to external L_{Aeq} levels of at least one of those levels to a total external level which represents an increase of more than 3 dB using worst-case assumptions for a 15-year period following first use of the development.

In the case of development which is neither conventional transportation nor industrial or commercial, such as recreational and sporting activities or small aviation developments, the noise climate which would be likely to result should be predicted or estimated using a combination of field measurements (where possible) and established acoustical calculation methods. The change in the three descriptors most widely used for characterizing noise climate, namely L_{A90}, L_{Aeq} and a suitable method of representing typical maximum noise levels (eg the decibel average of a representative number of L_{Amax} levels) should be measured or calculated with and without the development. Changes in any of the descriptors of 3 dB or more are an indication that the development would potentially have a noise effect which should be carefully considered. The most valid way of considering numerical noise levels is to use them for the purposes of comparison with known cases of comparable nature in which information on the extent of disturbance to people is available, either in the form of published technical reports of noise and social surveys, or the experience of local authorities with similar developments. Where noise measurements are made for this purpose, some guidance is available in BS 7445 [10].

Local authorities should keep and make generally available all data which they obtain on noise levels and known public response to the noise sources concerned.

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NOISE CONTROL AT AN ALL-NIGHT EVENT AT TURWESTON AERODROME

Robert Peirce MIOA & Kevin Garthwaite AMIOA

Introduction

Since the Noise Council produced recommendations that music from night-time events *should not be audible within noise sensitive properties with windows open in a typical manner for ventilation* [1] the majority of one-off night-time events have adopted an inaudibility criterion within the licence conditions. At an all-night music event at the Turweston Aerodrome near Brackley, the Local Authority adopted a noise criterion which stated that *noise levels shall not exceed $L_{Aeq,10min}$ 45 dB as measured at a distance of 1m from any noise sensitive dwelling.* This article reviews the noise criteria for night-time music events in the light of the results of the Turweston event.

The Turweston site prior to the event

Rational Behind Conditions Set at Turweston

The noise condition of $L_{Aeq,10min}$ 45 dB, as measured at the façade of any noise sensitive dwelling, was based on the guidelines provided in the 1980 World Health Organisation report [2] which recommends an internal sleep disturbance criterion of less than 35 dB L_{Aeq} to preserve the restorative process of sleep. However it should be noted that these guidelines have been superseded by the WHO Criteria Document on Community Noise, 1995 [3] which states that *where noise is continuous, the equivalent noise level should not exceed 30 dB(A) indoors, if negative effects on sleep are to be avoided.* The $L_{Aeq,10min}$ 45 dB condition was derived from the internal sleep disturbance level of 35 L_{Aeq} plus 10 dB attenuation from an open window (based on research by the BRE which indicates that an open window provides around 10 – 15 dB attenuation). The Local Authority also felt that it would be appropriate to set a low frequency limit of 70 dB in either of the 63 and 125 Hz octave frequency bands which was taken from the Noise Council's guidance notes [1].

The $L_{Aeq,10min}$ 45 dB criterion was adopted by the Local Authority in favour of the inaudibility criterion as it was considered to present a fairer balance between noise disturbance of nearby communities and the enjoyment of the event for around ten thousand members of the audience. A criterion based on the prevention of sleep disturbance was considered appropriate for a one-

A typical all-night dance event

off event rather than complete inaudibility within noise sensitive dwellings.

Inaudibility

The objective for the Local Authority at the Turweston event was to set a noise condition at which the event could be held successfully whilst still allowing local residents to enjoy a reasonable night's sleep. In setting the condition it was borne in mind that this was a one-off event and the Council would be unlikely to grant a licence for a similar event at this location more than once per year. The Local Authority asked itself the question, *is inaudibility a reasonable condition?* It was considered that the priority was to ensure that residents were able to sleep whilst accepting that most reasonable people would tolerate a small degree of noise for a one-off event.

It was the view of the Local Authority that inaudibility also presents monitoring and enforcement problems. The EHO would have to visit every complainant and listen to the noise within properties which would take a great deal of time and might ultimately lead to delays in getting the noise reduced. The EHO would probably have difficulty in finding some of the properties in small rural villages with their unmarked lanes and tracks. Indeed the process of driving around quiet lanes and walking up and down long driveways to find properties, could cause a measure of disturbance in itself.

The Local Authority also observed that inaudibility was not considered appropriate for inclusion by those who drafted the new Noise Act 1996 which takes an internally measured 35 dB(A) as an upper limit to intrusive neighbourhood noise.

There is a view that inaudibility as a licence condition can encourage complaints from residents who may have fears about such an event which are unconnected with noise. As a result pressure might be put on an officer by some complainants to reduce noise levels below that which the officer would normally consider to be rea-

sonable. Experience shows that a minority of local people who are strongly against such events (it is widely held that raves have a poor media image) may well seek to have an inaudibility criterion imposed by the Local Authority to register their feelings about the event rather than being genuinely disturbed by the noise.

Finally, inaudibility is of course subjective, and this raises issues over enforcement. Clearly background noise levels in a dwelling create a problem as do personal variations in hearing acuity.

The Turweston Event

It is likely that most readers have little or no experience of all night raves. At this particular event there were 6 marquees, each with separate sound systems which ranged in power from 5 to 20 kW. Other significant noise sources at the site included a fairground and noise from the audience, especially when thousands of people used trumpets or horns simultaneously. It was observed that the noise from the marquees was dominated by low frequency rave music, often with the Master of Ceremonies 'shouting encouragement' over the music.

Location

This particular event was licensed between 1900 to 0700 hours on a Saturday night in August 1997 and it was the first time that this venue had been used to hold such an all-night music event. Turweston airfield is an ex- World War 2 airfield situated on the north west edge of rural Buckinghamshire and is currently used as a flying school. The nearest villages of Turweston and Whitfield in neighbouring Northamptonshire are located approximately 1.5 km and 1.25 km respectively from the event and can be considered as affluent rural villages, where experience suggests that noise complaints are likely. The nearest large town is Brackley which is located over 2 km away.

Measured Internal and External Noise Levels

To keep the noise levels to within the $L_{Aeq,10min}$ 45 dB criterion at the nearest properties the internal noise levels within each marquee were generally controlled to a level of between 96 to 98 dB(A). Further control was also required to reduce the impact of both the speech component and the low frequency component of the noise throughout the night. If noise levels were found to increase at the nearest properties then immediate reductions were implemented in the marquees. Depending on external observations, either the overall noise levels (a blanket reduction for each marquee) or individual noise sources (when these could be identified) were reduced. This enabled the $L_{Aeq,10min}$ 45 dB noise condition to be met throughout the night. At 0500 the noise levels rose at the nearest village by approximately 5 dB(A) and temperature inversion effects were thought to have been partly responsible for this; accordingly the music noise levels in the marquees were reduced to between 90 – 93 dB(A) at that time. The weather conditions on the night of the event were warm and calm with no significant wind component, a fact that assisted in the control of the noise.

Noise Complaints

The council set up a telephone hotline at their control centre at the event and this was widely publicised through the local parish councils and in the media. On the night a total of 19 households phoned to make complaints about noise from the event which began at 1900 and ran through until 0700 the following morning. Between 1900 and 0030 only one complaint was received from a property in Whitfield where the noise level had risen to about 48 dB(A). The level was reduced to around 43 dB(A) and the complainant telephoned back to say that he was satisfied with the reduced level. No further complaints were received until 0030 when in the space of one 45 minute period about 15 complaints were received from the Turweston/Brackley area. The Local Authority measured levels of about 50 dB(A) at Turweston village and the complaints ceased after the music noise levels were reduced to below 45 dB(A).

Three additional complaints were received at other times but the assessment of the patrolling officers was that of 'over sensitivity by the complainant'. At one of these locations a facade level of 34 dB(A) was measured and at another the officers could not make a valid measurement above the level of traffic noise on a nearby main road. On talking to these residents it became evident that their objections to the event were not wholly noise-related and included light pollution from the fun fair rides and a concern for local wildlife.

At around 0400 a complaint was received from Whitfield and the façade levels were found to have risen to around 48 dB(A) which was taken to have derived principally from a change in atmospheric conditions. Throughout the event there appeared to be a correlation between the level of complaints and the short periods when 45 dB(A) was temporarily exceeded.

Conclusions

The wider consensus among the officers and consultants involved was that the environmental noise levels were controlled successfully at the all-night dance event at Turweston Aerodrome through the use of an objective noise criterion in the licence conditions rather than inaudibility. The onset of noise complaints closely matches transgressions of the $L_{Aeq,10min}$ 45 dB noise condition which indicates that an absolute noise level can be used to effectively control the noise from all-night dance/music events. It seems quite likely that the imposition of an inaudibility criterion at Turweston would have prevented an otherwise successful all-night event from taking place.

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- **modelling**

As previously, the presentation of practical systems and results will be encouraged and a poster / demonstration session will be a key feature of the conference. Prospective authors should indicate whether their proposed paper is better suited to oral or poster presentation.

Prospective authors are invited to submit a 200-word abstract not later than 15th May 1998. Successful authors will be notified by mid-June 1998. Complete manuscripts may be up to 8 pages long, including diagrams, and must be prepared in the correct camera-ready format (a WORD template file will be available). Manuscripts must be in the hands of the conference secretary by 30th October 1998; those arriving after this date will not be printed. The conference proceedings will be published in book form in Volume 20 of the Proceedings of the Institute of Acoustics (1998), and copies will be available at the beginning of the conference.

The conference will take place at the Prince Regent Hotel, which is situated on Weymouth seafront. Full board and accommodation will be available.

For further information, and the address to which abstracts should be sent:

Professor Hugh Griffiths
Department of Electronic and Electrical Engineering
University College London
Torrington Place
LONDON WC1E 7JE, UK
tel: (44) 171 380 7310 fax: (44) 171 387 4350
email: h.griffiths @eleceng.ucl.ac.uk

Institute of Acoustics, 5 Holywell Hill, St Albans, Herts AL1 1EU
Tel 01727 848195 Fax 01727 850553 email Acoustics@clus1.ulcc.ac.uk Registered Charity No 267026

EDUCATION

Certificate of Competence in Workplace Noise Assessment

The following were successful in the February 1998 examination

Amber
Belson, M J
Harris, A D
Phillips, C A
Weaver, P
Westland, G
Whitaker, B H

Colchester
Breeze, A S
Cherry, P
Hunt, J
Maxwell, R
Nicholls, A P

EEF Sheffield Assc
Ali, A
Black, N J
Cooney, M A
Ellaby, S W
Hutchison, A S
Northover, D N
Schofield, P F
Sidwell, W H

Sykes, P
Waters, P R
Wooley, J K

Liverpool
Barry, P
Drury, G
Mawdsley, C E
McDermott, I

Staffs
Burch, L O

Meikle, J

Ulster
Corcoran, D A
Doyle Fleming, E
Gilmore, A
Johnston, F
Kilcoyne, C
Niland, P
Reid, K
Roche, C
Sherif, D
Walsh, R J

MEMBERSHIP

The following were elected to the grades shown at the Council meeting on 26 February 1998

Fellow
Cogger, N D

Member
Brownstone, M S
Canham, R H
Chan, L F J
Duffy, G
Gallaher, A B
Gillan, F S
Ho, H L
Ho, S K
Lee, K F
Longhurst, M J
Lowson, J V
Man, C T
Marchant, I J
Meed, T
Poon, T C
Thurgood, D W
Ward, P D
Woo, T K
Wylie, R J
Yap, S H

Associate Member
Bandle, A M
Collie, J
Chan, S H
Daley, J K
Davis, T A
Fuller, S E
Grayling, J
Haddad, R P
Leach, S C
Minto, C D
Newhall, D K
Pamley, R J
Solway, J W
Taylor, P
Webster, S J

Associate
Butler, M
Fudge, G
Holmes, I P
Kushwaha, M

Student
Channon, D
Cullen, J S
Jesus, L M

INSTITUTE DIARY 1998

31 MAR - 2 APR
Acoustics '98 IOA Spring Conference
Cranfield University

22 APR
London Branch
One-day Meeting
Construction Noise and Vibration
London

23 APR
IOA Publications, Meetings Committee
St Albans

24 APR
Eastern Branch Annual Dinner
Colchester

30 APR
IOA Membership, Education Committee
St Albans

12 - 14 MAY
RoSPA Exhibition, NEC

14 MAY
IOA Council and Institute AGM
St Albans

15 MAY
IOA CofC in W'place Noise Exam
Accredited Centres

21 May
Eastern Branch
Evening Meeting
Planning and Noise
Bury St Edmunds

5 JUN
IOA CofC in Env Noise M'ment exam
Accredited Centres

9 JUN
Instrumentation & Measurement Group
One-day Meeting
Good Practice in Acoustical Measurements
London

10 Jun
Midlands Branch
Evening Meeting
Motor Sport Noise
Donnington Park

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

18 - 19 JUN
Diploma examinations
Accredited Centres

9 JUL
IOA CofC in Environmental Noise M'ment Advisory Committee
St Albans

20 - 21 JUL
Underwater Acoustic Calibration and Measurements Symposium
Underwater Acoustics Group
National Physical Laboratory

17 SEP
IOA Publications, Meetings Committee
St Albans

24 SEP
IOA Membership, Education Committee
St Albans

1 OCT
IOA Medals & Awards, Council
St Albans

9 OCT
IOA CofC in W'place Noise Exam
Accredited Centres

22 - 25 OCT
Reproduced Sound 14
Electroacoustics Group Conference

ENGINEERING COUNCIL: QUARTERLY ARTICLE: FEBRUARY 1998

Mike Heath

We would, I am sure, all agree that a major task of the engineering profession is to enhance the influence of engineers at all levels of society, for a whole variety of reasons.

One of the most important is to ensure the continued recruitment of talented young people of the highest calibre, and guarantee that their education, training and professional development prepare them as world class professional engineers. Another is to have greater input to the national decision-making process.

As engineers, we know well that a convincing argument rests on good evidence and facts. It is therefore surprising that these have been in short supply in the past. It has been an important aspiration of the new Engineering Council to rectify the situation and, as far as possible, act as a centre for factual information about engineers and engineering and assemble the necessary statistics.

Considerable progress has been made in this direction and I would like to take the opportunity of sharing with you some of the information and our deductions from it. For a start, we can demonstrate that engineering is for most a well-paid profession and that an engineering degree is one of the surest routes to business success.

A recent report by the Institution for Employment Studies tracked the job experiences of all Sussex University graduates over a 42 month period. It showed that, six months after graduation, engineering graduates were more likely to be employed than any other discipline. After 42 months, no engineers were working part time, unlike 14% of humanities and creative arts graduates. Average salaries were £15,750, beaten only by mathematical sciences graduates (mostly computer scientists) on £15,787.

The Engineering Council's 1997 Survey of Professional Engineers and Technicians illustrates that not only are salaries, on average, continuing to rise at a rate well above inflation, but unemployment rates are extremely low and still falling. With their earnings averaging £40,131, Chartered Engineers, for example, are better paid than Chartered and Certified Accountants (£28,033), solicitors (£34,860) or architects (£25,272).

Another recent study, this time by the Higher Education Funding Council for England and Wales, looking at 38 different disciplines, has shown that the salaries of engineering graduates ten years after graduation are in the top echelon of the earnings league. Their salaries are significantly bettered only by those of their peers pursuing careers in clinical dentistry, law and economics but are ahead, for example, of most medical professionals.

What about the prospects of getting to the top? Six per cent of engineering undergraduates are engineers so, pro rata, one might reasonably expect that six per cent of university vice-chancellors were engineers. In fact the figure is eighteen out of 107 or 17 per cent. And should anyone have any doubt about the engineering and scientific credentials of chief executives of FTSE 100 companies, a snapshot check of some 57 of them found that 11 were Chartered Engineers – again, a much higher proportion than would be expected pro rata.

A DTI sponsored study last May by the Institute for Employment Research into the chief executives of 43,000 manufacturing companies found that, of those who had formal qualifications, engineers and scientists outnumbered accountants three to one despite the professions being roughly equal in size.

It seems that industry cannot get enough engineers and there are shortages at every level. A new report from the Association of Graduate Recruiters shows that in both 1996 and 1997, good quality engineers were easily top of a list of shortfalls among their members. This is the message of new SARTOR – the new CEngs will be much sought after, but at least employers will be able to distinguish them from the rest. Although the higher education establishments are turning out enough engineers by quantity (apart from a bulge from 1991 – 1994, acceptances to engineering degree courses at 17,000 per year, compare well with previous years), too many have neither the ability nor the competencies that industry requires.

We have asked the Higher Education Statistics Agency (HESA) for statistics on A-level point scores for entrants to engineering degrees. In 1994 when many former polytechnics became universities, the scores dipped significantly as many academic institutions went for numbers rather than quality. The number of 24+ point candidates seemed unchanged. The scores have recovered since then but are still disappointing. Although we continue to seek adequate output measures for higher education performance, these scores do give a crude indication that engineering is not getting its fair share of the nation's academic quality. This is something, of course, that SARTOR is designed to address.

Another interesting piece of work is a study by the IKE on job advertisements for engineers. The number that specify Engineering Council registrants has been steadily rising and, taking the Daily Telegraph advertisement pages as an indicator, 35% now call for chartered status, so our efforts as a profession to maintain and improve standards are clearly valued.

All these statistics help us towards a clearer picture of where we are in engineering and where we might be going. There is much more work to be done in devilling out the statistics and drawing the right conclusions but I hope you will agree that work so far is encouraging.

The Digest of Engineering Statistics produced by the Engineering Council last year will be published annually and the 1998 edition will look very different to the 1997 edition, thanks to helpful suggestions made by Institutions. I hope, nevertheless that anyone with further ideas on useful statistics we might investigate will let us know.

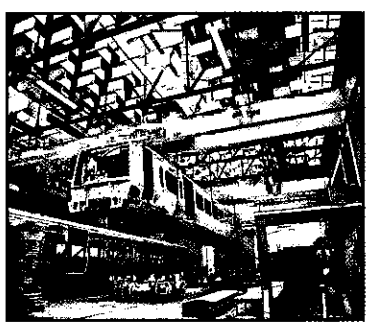
Mike Heath is Director General of the Engineering Council ❖

Industrial Noise Control

Safeguard people's hearing levels

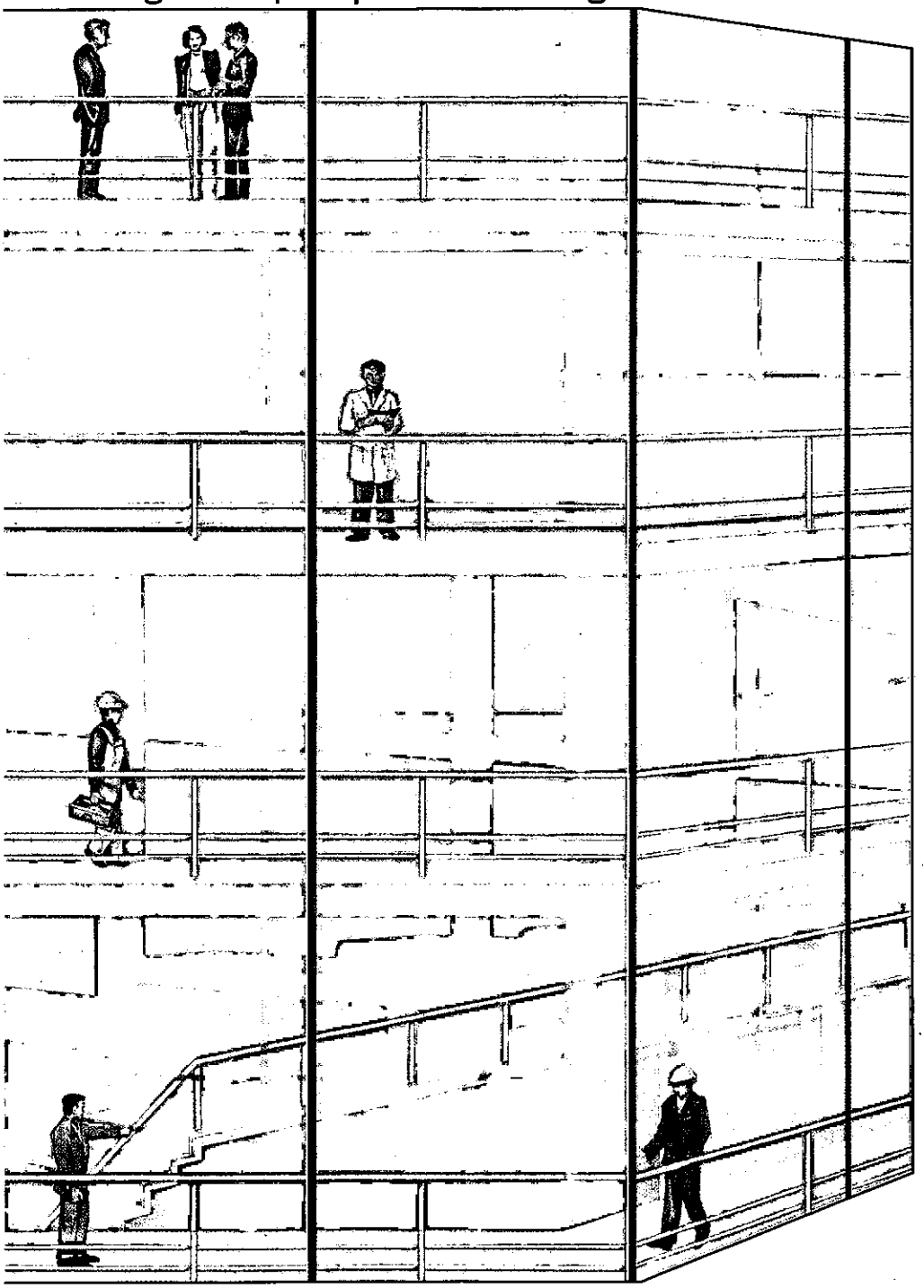
Busy Works Office

Process and Production Areas



Heavy Industry

Environmental/Neighbourhood Noise Control

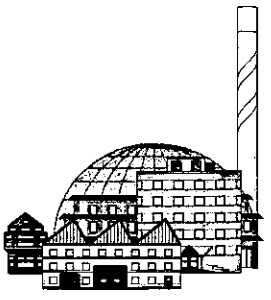


For further information contact:

ECOMAX ACOUSTICS

Ecomax Acoustics Limited (Head Office)
Gomm Road, High Wycombe. Bucks HP13 7DJ
Fax: 01494 465274 Telephone: 01494 436345

Consult the Professionals
for Noise Control Solutions



THE INSTITUTE DIPLOMA EXAMINATION 1997

Dr J M Bowsher HonFIOA

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 184 (194 last year) and the overall pass rate 84.4% (83.9% last year), including all projects. Candidates who did not submit their project report by the set date are shown in the table to have failed.

Administration proceeded smoothly this year, but there were some problems connected with the extremely late submission of marks from two centres. Once again, both I and Jeff Charles, the Deputy Chief Examiner, would like to thank Linda and Kate in the office for their hard work in processing all the correspondence from centres and for checking every script for arithmetical and other errors in marking. The written paper moderating session in August went smoothly, and no cases demanded difficult decisions.

In the 1997 Diploma, the General Principles of Acoustics Module was (as usual) assessed partly by course work. Laboratory reports and assignments set throughout the year were graded and contributed 20% of the total mark. I regret to report that agreed arrangements to assess candidates' performances on the important Section G of the syllabus by assigned coursework were not implemented, despite my strictures in 1996. The overall practical effect of coursework was to raise the mean mark on the paper by 0.9% and reduce the sample deviation of the marks from 22.3 to 15.3. The coursework formed a 'hurdle' and three candidates failed the whole paper for this reason.

A recurring feature of the results is the very good performances of the Distance Learning candidates overall, and of those from Colchester Institute in the GPA module. A matter of concern, though, as usual, was the small number of GPA questions from centres. The paper is made up from suggestions by Tutors all over the country; sadly, those that were received did not cover the whole syllabus.

The Institute awards a Prize to the candidate who performs best in the examinations in any one year. The minimum criterion for the Prize is that the candidate should have obtained three merits in the written papers and at least passed in the project. This year, three candidates fulfilled this criterion, one by only a small margin. I was delighted to award the Prize to Mr M George and to Specially Commend Mr P L Moore.

Conclusions should not be drawn from the very small number of Appeals, the number of Appeals this year was 3; it was four last year.

This is my last report as Chief Examiner, next year Professor Keith Attenborough from the Open University takes over. It has been a privilege to serve the Institute during the past nine years and to contribute to the development of the Diploma and the success of so many candidates. Over the years I sought to introduce a number of reforms which I felt would enhance the stature of the Diploma, but not all have been welcomed or implemented. The process was not without its problems and during the latter portion of my term of office put a considerable strain on my health. However, I am sure that my successor will continue to build on the foundations that I have laid, and the Diploma will remain a qualification coveted by acousticians. I wish Keith every success in this responsible position.

	General Principles of Acoustics			Architectural and Building Acoustics			Law and Administration			Measurement			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	Merit	Pass	Fail
Bristol	0	9	4	0	0	0	0	8	5	0	0	0	1	9	3	0	0	0	0	0	0	0	0	0	0	6	9	1	32	21
Colchester	1	20	1	0	0	0	1	15	1	0	0	0	4	18	3	0	0	0	0	0	0	0	3	3	1	18	4	7	74	12
Col NE London	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0
Derby	2	28	1	3	3	0	3	19	0	0	0	0	2	14	4	0	0	0	1	23	2	0	0	0	9	19	5	20	106	12
Leeds	1	16	1	0	0	0	0	15	5	0	0	0	2	14	4	0	0	0	0	0	1	0	0	0	0	11	4	3	56	15
NESCOT	1	16	2	0	5	1	1	15	4	0	0	0	2	4	0	0	0	0	2	11	2	0	0	0	6	11	3	12	62	12
Newcastle	0	5	0	0	0	0	0	4	1	0	0	0	1	4	0	0	0	0	0	0	0	0	0	0	0	4	2	1	17	3
Sheffield	0	5	0	0	0	0	1	4	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	6	0	1	20	0
Distance Learning	10	19	3	2	12	1	3	10	2	0	0	0	5	20	4	2	1	0	0	1	0	1	5	0	6	18	8	29	86	18
Totals	15	118	12	5	20	2	9	90	18	0	0	0	17	88	18	2	1	0	3	35	5	1	8	3	22	94	35	74	454	93

Diploma in Acoustics and Noise Control
Grades awarded to 1997 candidates from each centre

1997 Diploma Pass List

Tutored Distance Learning
Ball, M D
Burns, S M
Carlin, S
Dobbyn, R A
Donagh, E J
Edwards, J C
Entwistle, A
Findlay, A G
French, S J M
Greenhalgh, P N
Hankin, P J
Hill, T G
Isherwood, M P
Kinghorn, C L
Moore, P L
Patrick, L M
Pullin, M V
Richardson, P S
Robinson, P A
Rogers, P J
Shannon, A J
Sharp, R G
Smith, A J
Suri, S S

Bristol
Bignall, C G
Freegard, J P
Pitt-Kerby, K B

College of North East London
Lockwood, R J C

Colchester
Austin, N C
Buckland, L A
Calvert, R L
Collie, J L
Daley, J K
Edwards, P
Flatt, S J
Froud, M E
Harris, H J
Herbert, J A
King, G J
Luck, A J
Mann, J K
Metcalfe, K J
Middleton, S A
Stone, L C
Taylor, P
While, P J
Wilkinson, A

Derby
Bell, S J
Bethell, S
Bettaney, T A
Blackwell, A
Bowen, I C
Clamp, G E
Davies, J C
Davis, T A
George, M
Greenwood, D R
Gregson, M R
Harley, I M
Hickin, C M
Higgins, A S
Hillard, N D
Howard, D I
Jones, W D
Krahmer, R J
Lucas, A
Mahmood, A
Merrin, A
Moyes, S A
Nealon, K M
Phillips, D V
Pickering, G D
Reid, J L
Reynolds, P L
Staite, M A
Street, N A
Turner, G
Watts, D A
Willfratt, J M
Wright, M

Leeds
Brown, R
Craig, L
Duncalf, K
Farmer, I D
Firth, R E
Holroyd, G W
Ormerod, L C
Pritchard, G
Robb, J L
Tarn, G
Wetherill, R
Yip, M M

NESCOT
Collins, N M
Davis, I J
Elliott, M J
Fuller, S E
Griffiths, S D
Haddad, R P
Hepburn, G
Le Besque, C A
Marchant, I J
Murison, C L
Newhall, D K
O'Brien-Wheeler, K J
Parker, S J
Quashie, V E
Smith, J P S
Tomsett, G J
Wheller, J
White, R

Newcastle
Crawford, J
Donald, F L
Jones, A

Sheffield
Blenkinsop, D G
Hay, D
Hill, J A
Richardson, C W
Terry, J
Urbanski, I D

Diploma in Acoustics and Noise Control

Tutored Distance Learning

This mode of study is primarily intended for students who have difficulty 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 complete an investigative project.

Face-to-face tutorial arrangements are normally based on regular meetings in small groups with an approved tutor. Because of the variable travelling distances involved, these are arranged at several centres.

Tutorial groups start their studies on various dates between April and October as and when a number of students in that geographical area obtain clearance from their employer. All groups prepare for the Institute examinations in the June of the following year.

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.

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 which is offered, subject to demand, at eight Accredited Centres in the UK.

The award of the Diploma immediately satisfies the requirements for election to the non-corporate grade of Associate Member of the Institute, conferring the use of the designatory letters AMIOA. It also satisfies the academic requirements for Corporate Membership of the Institute. Election to the grade of Member (MIOA) involves in addition the fulfilment of certain experience requirements which usually amount to three or more years spent in a responsible role in a position directly related to acoustics, vibration or noise control.

Hansard

28 January 1998
Railway Noise
Mr Nick St Aubyn (Guildford): I thank those in Madam Speaker's Office for selecting my debate. I also thank hon Members who have expressed their support, but who – understandably, given that this is a busy time – cannot be present.

One of the things that I have appreciated since becoming a Member of Parliament is the way in which Members are prepared to debate not just great matters of state, but issues that – although they affect the lives of only a small number of people – raise principles of wider significance. That is particularly appropriate when we are discussing remedies that the House intended to be available to such small groups, but which have been discovered to be defective.

The subject of the debate directly affects residents of Rupert Road in Guildford – whose petition I have here – but it also raises three matters of wider principle. First, how are the railway operators to be made accountable for their impact on the environment? Secondly, are those who live near railways receiving fair compensation for that, at a time when it is intended that there will be investment in the rail network so that it will be improved and its use intensified to a greater extent than for many years? Thirdly, when the use of rail and road networks increases, do we reflect the cost to those who live nearby of the benefits that accrue to the rest of us, as a result of such intensification of use?

I have always been a friend of the railways. The garden of my previous home abutted the main railway line. Equally, those who live in Rupert Road in Guildford chose to go there in the full knowledge that their road abutted a busy mainline railway station. They had been there for many years when our saga began 21 months ago, when Railtrack decided, without any apparent consultation or a requirement for detailed planning permission to take advantage of a disused siding and erect what is effectively a new maintenance depot to service its mainline operations and to help in its vital signalling work on that line. That involved the creation of new road access, the erection of offices and electrification of disused line.

As I said, the developments did not require Railtrack to consult local residents or even the council. However, when the project was under way the noise began for those who lived in the immediate vicinity. I shall quote from one of the letters that I received from the residents, to give a flavour of the noise and difficulty that they face. In her letter, a lady states:

'I do not think we have had an uninterrupted night's sleep this week. On Monday I was woken at 3 am by what sounded like someone throwing bricks at a metal sheet for half an hour. On Tuesday night my neighbours called the police after South West Trains left a diesel engine parked by the fence with the engine roaring and the compressors screaming every three minutes. The Environmental Health Officer came out and took measurements which recorded this at over 70 decibels.'

There are many similar incidents to which I could refer. Residents have had to take days off work to recover from the night time noise and they have had to take days away from home. A family with three children who live by the railway were especially affected by the fumes from the new activity. The three children have asthma and I presume that 'Thomas the Tank Engine' is not their favourite bedtime reading.

I pay tribute to Guildford Borough Council, and especially to the Environmental Health Officer, Mike Keetch, who has worked tirelessly on the case from the end of 1996, when the residents asked for his help in the matter. That has required the installation of detailed recording equipment and being available at all times of the day and night to ensure that evidence is properly gathered. A council report states that on one occasion 'the normal background noise level of about 44 decibels was raised for periods as high as 76 decibels which is a loud and intrusive noise level.'

Railtrack took nine months to respond to entreaties by the council, let alone the earlier entreaties by residents, for a meeting to resolve the serious problems that the new and intensive development had caused. In view of what was agreed at that meeting, it is striking how simple were the steps that Railtrack had to take to at least alleviate the problems that it had caused. They included such simple measures as erecting signs along the railway telling drivers and workers that they should keep noise to a minimum and noise control provisions in the contract terms of Railtrack operators. One would have hoped that such simple measures would be implemented without delay. However, a Guildford Borough Council officer who wrote to me about the matter stated in his letter: 'Since that date efforts have been made to contact Railtrack and seek confirmation of the steps that they propose to control noise. No response has been received ... although a meeting has been arranged at my request on 3 February.'

Over the past week, since this debate was scheduled and in the light of the next week's meeting, there has been a short respite in the noise and difficulty caused to residents. I hope that the attention that has been drawn to the matter will have the effect that was intended and desired by legislation.

I contacted the Department of the Environment, Transport and the Regions and discovered that it was its understanding that the Environmental Protection Act 1990 governed Railtrack and other rail operators. Guildford Borough Council took a great deal of trouble in collecting the required evidence and information, and was on the point of issuing proceedings against the rail company. It discovered that section 122(3) of the Railways Act 1993 gives all rail operators a statutory defence against the Environmental Protection Act. Those who take action against the rail operators have to prove that their operations and actions were, in the words of the section, 'totally unreasonable'.

Hon Members will be aware that it is difficult in law to prove that an action is totally unreasonable even if it appears to be unreasonable and, as in this case, the rail operator has admitted that an equally viable site could have been chosen away from housing. It is a measure of the deficiency of the legislation that because no consultation was required, that alternative proposal was not presented, although its implementation would have relieved the residents of the difficulty.

The residents also examined the Land Compensation Act 1973, to see whether there were legal requirements on the rail operator to give grants to the residents for the cost of insulation. Noise regulations issued in 1996 require that if noise during the day is more than 68 dB, or is more than 63 dB at night, compensation should be paid to residents. However, that is restricted to cases in which a new line is to be opened or when additional tracks are laid alongside an existing line. It does not take account of the revival of a long-derelict line. Even the electrification of such a line or the erection of depot buildings alongside do not count. Those are all signs not just of intensified use but of a material change in the use of the rail network.

It was also decided to seek the aid of the Rail Regulator, who issued environmental guidance in March 1996. The foreword states:

'There is of course in place in this country extensive and detailed legislation aimed at protecting the environment. It would not be appropriate for me to try to summarise current requirements and standards in a document of this kind.'

The implication is that the regulator assumed that operators such as Railtrack would be beholden to the environmental legislation. The regulator's guidance is therefore sadly lacking in specifics. When he speaks of railways' impact on the environment, for example, he states merely that *mitigation of noise nuisance will require measures to be taken by train operators, rolling stock companies, Railtrack and the infrastructure maintenance companies.*

That long list of those involved shows just how difficult it is to ensure that everyone involved in the railways heeds an effectively voluntary regime. Moreover, the voluntary regime specified in the guidance note is not nearly specific enough.

The problems at Rupert Road have continued – although, as I said, they have abated somewhat in the past week. It is very much hoped that, because attention has been drawn to the matter, Railtrack will recognise its responsibilities to the community. Where Parliament has given any exemption from mainstream legislation – particularly from environmental legislation – a duty of care surely rests on those granted the exemption or licence to act extremely responsibly and, wherever possible, to observe the spirit and the letter of the law.

I believe that the Minister and her Department can make a difference in three specific matters. First, I hope that they will support the call for the regulator to issue to the rail operators new and more specific guidelines on environmental impact. I suggest that such guidelines should spell out how, before an intensification and material change of use occurs, operators should undertake a process of notifying local residents and the local authority, and undergo a period of consultation during which they must demonstrate the reasonableness of their proposals and the lack of any alternatives.

Secondly, the regulator should propose model clauses on environmental impact, so that those who work for the rail operators are bound by a legal and effective system to ensure that the type of suffering and disruption caused to the residents in Rupert Road does not happen again there or elsewhere. The operators could use such clauses in negotiating contracts with their subcontractors.

Perhaps the Minister will confirm that the Government intend to introduce a new transport Bill. If so, will Ministers consider incorporating in it a revision of the terms of the Railways Act 1993 – thereby changing the terms of the section effectively exempting rail operators, so that their operations are more tightly and more clearly defined when they impact on the environment and cause a nuisance to those living near railways.

Thirdly, there is the wider issue of the Land Compensation Act 1973. I speak as an hon Member representing a constituency through which a main road – the A3 – thunders, and in which the intensification of road use is every bit as much of a problem to constituents as the intensification of rail use. The Land Compensation Act 1973 is now 25 years old. Even if the regulations could have been extended – I do not believe that they could have been – to deal with the situation in Rupert Road, there are many

deficiencies in the way in which we assess and measure the effect on those living near our roads and rail networks.

I hope that the Minister and her Department, in promoting those suggestions, will bring pressure to bear on the rail operating companies so that they re-examine their scope for agreeing discretionary grants in cases that are currently in a grey area. The operating companies certainly have power to make discretionary grants to alleviate the noise caused to local residents.

Above all, I hope that this Adjournment debate will promote a wider debate on the issues that have been raised.

The Parliamentary Under-Secretary of State for the Environment, Transport and the Regions (Ms Glenda Jackson): I congratulate the hon Member for Guildford (Mr St Aubyn) on obtaining this debate and on learning so soon after his election to the House that the Chamber is not reserved for matters of great moment – although I argue that no matter is of greater moment than the concerns of one's constituents. I congratulate him also on presenting those concerns so cogently and in such detail. The issue that he raises is particularly important.

I am sure that the hon Gentleman will agree that, on balance, railway transport is more environmentally friendly than road transport. Undoubtedly, however, it still generates noise. Although noise from railways tends to be less disruptive than noise from motor vehicles, and noise experts consider it much less of a problem and much less disturbing to sleep than road or aviation noise, that is of little concern to those of his constituents suffering from the instance that he described in such detail.

The hon Gentleman will know that the Government are committed to developing an integrated transport policy and that, this spring, we intend to issue a White Paper detailing a strategy for the United Kingdom. As part of that strategy, and within an environmentally sustainable framework, the Government wish to encourage greater use of the rail network for both passengers and freight.

With greater passenger usage of the rail network and with moves to increase the percentage of freight traffic transferred from road to rail, there will inevitably be increased railway noise for many people who live close to railway lines. Our aim must therefore be to minimise railway noise as much as possible.

For many years, I lived over a very busy main line and, like everyone who has lived in a property near a railway line, I was aware that traffic patterns can change and that volumes can increase. However, some of the hon Gentleman's constituents are particularly concerned about noise from engineering trains using sidings in the Guildford station area. Of course, I regret any inconvenience caused to his constituents, but I am advised that those sidings are used by vehicles employed on essential maintenance or on major investment projects to modernise signalling systems in the area. That activity is centred in Guildford because it has easy road access and the necessary services, and it is close to stores and stockpiles of necessary materials.

I regret that the efforts of Railtrack and its contractor to reduce noise at the site have not been successful in reducing the disturbance to local residents. I understand that residents have now been given a 24-hour Railtrack helpline number so that they may contact the company when necessary, and that Guildford Borough Council has arranged a meeting with Railtrack, on 3 February, to discuss the problems being caused to local residents.

Railtrack has advised me that the project to modernise signalling systems in the Guildford area is due to be completed in July 1999, and that that will reduce some of the disturbance to local residents. However, engineering trains and sandite trains – which put sandite on to the rails to help adhesion during leaf fall in the autumn – will continue to use the sidings at Guildford. The major Railtrack investment programme to improve signalling will bring benefits for many thousands of rail commuters across the south-east, but the related works will cause some inconvenience to people living nearby until they are completed.

Railtrack has assured me that it wishes to be a good neighbour to those who live adjacent to the operational railway – not only in Guildford but across the country – and that it tries to do all that it can to mitigate noise and nuisance caused by track or line-side works.

In major works, Railtrack gives advance notice to the local authority and line-side residents and, in some cases, has offered to accommodate residents in hotels. However, if Railtrack has to perform emergency safety-related work, it may not be possible to give advance notice to residents likely to be affected.

Although there is no statutory limit for railway noise both Railtrack and train operators are subject to the statutory nuisance provisions of the Environmental Protection Act 1990, which are enforced by district councils. Under section 79 of the Act, it is the duty of district councils occasionally to inspect their areas to detect any statutory nuisances, and to take such steps as are reasonably practicable to investigate any complaint made by a local resident. Section 80 of the Act provides for the serving of abatement notices where a local authority is satisfied that a statutory nuisance exists, or is likely to occur or recur. In addition, a magistrates court may act under section 82, following a complaint by any person aggrieved by a statutory nuisance.

The hon Gentleman referred to section 122 of the Railways Act 1993, which provides Railtrack with some defence against the Environmental Protection Act 1990 where it is carrying out works as a statutory authority, but it is not an open ended defence to nuisance proceedings. Although the burden of proof required for conviction would be greater than if section 122 had not been enacted, it would be up to the local authority to convince a court that the noise generated by Railtrack was greater than might be reasonably thought necessary in order for Railtrack to carry out its statutory functions. I understand that the local authority has already taken up the case with the Rail Regulator. The Rail Regulator monitors the environmental performance of train companies and may be able to exert some pressure on Railtrack.

I turn from the specific case raised by the hon Gentleman to railway noise more generally. There is no statutory

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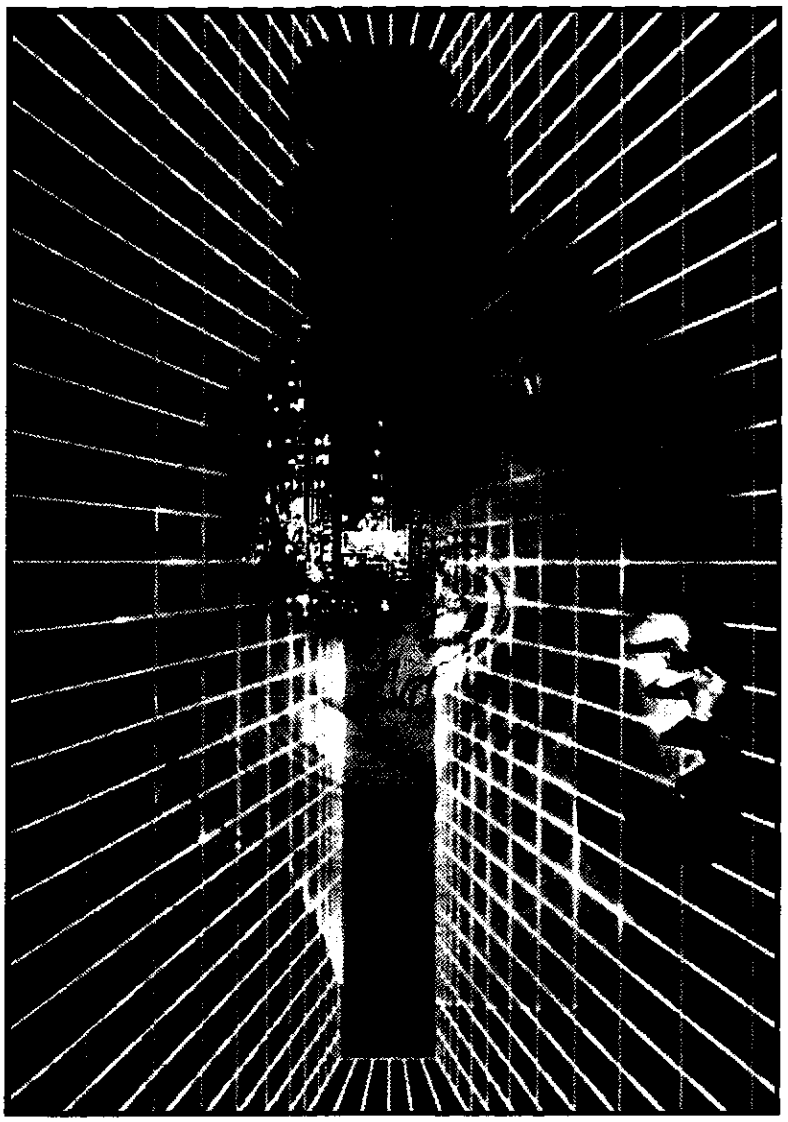

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provision for noise mitigation for those who live next to stations or shunting areas. It has always been accepted that those who buy property next to such areas do so in the knowledge that they will be affected to some extent by noise from the railway.

The Noise Insulation (Railways and Other Guided Transport Systems) Regulations 1996 provide statutory noise protection measures for people who live near new railway lines, or where a line is moved or widened. That is in line with noise insulation regulations offering statutory protection to people who live near new or widened roads. In recent years, a number of new railway projects have been planned or built, ranging from light railway systems to the channel tunnel rail link. The previous Government recognised that it was only fair that people living near new railway lines should be no worse off than people living near new roads.

The 1996 regulations confer a duty on the body responsible for the construction of a new railway line or additional tracks alongside a line to offer insulation when noise exceeds certain levels. There are two noise trigger levels: one for daytime and a separate, lower one for during the night. The standards reflect the character of railway noise – usually short bursts of noise followed by longer periods of quiet – and are expressed as an average noise level over a given time period. In addition, insulation may be offered against excessive noise from railway construction. In all cases, residents have the option of receiving a grant to cover the costs of carrying out the insulation work themselves.

The adoption of national standards ensures equity of treatment regardless of the area where people happen to live. That is very important. If noise insulation standards had to be determined separately for each individual rail project, unnecessary costs would be incurred and there would be a strong chance that people in one area would receive less protection than those in other areas. The certainty provided by setting national noise insulation standards benefits both line-side residents and promoters of new railway projects.

There is no provision in the regulations for insulation to be offered when use of a railway line intensifies. Again, that mirrors the position on roads. Successive Governments have taken the view that those who choose to live adjacent to roads or railways do so in the knowledge that the volume or composition of the traffic may change, and the householder must therefore bear the risk of that.

Although the Land Compensation Act 1973, of which the hon Gentleman is clearly aware, would not seem to benefit those in his constituency whose plight he has so cogently detailed, the Act allows householders to claim compensation from the responsible authority when the value of their property is diminished by physical factors, such as railway noise or vibration, caused by the use of new or altered public works. For railways, the Act is not specific as to what is meant by 'altered works'. but it refers to their being 'reconstructed, extended or otherwise altered'.

There is no statutory requirement for compensation to be paid purely because traffic on a railway line has increased.

That again parallels the situation for roads. For an altered railway line, it is for Railtrack to determine whether particular works undertaken are covered by the meaning of the Act.

Noise mitigation measures are one aspect of tackling noise, but train operators and Railtrack need to take reasonable steps to reduce railway noise at source. For example, railway noise can be reduced by measures such as replacing jointed track by all-welded track, the use of electric locomotives instead of diesel locomotives for hauling freight trains, and the use of lighter freight wagons. The Government propose to discuss noise levels, exhaust emission levels and energy efficiency with the railway industry with a view to gaining an understanding of what improvements the industry can deliver in those areas.

Noise barriers have proved effective in some instances, but they are undoubtedly expensive and, on occasion, replace noise disturbance with visual intrusion. Although there was no statutory entitlement to noise protection, sound barriers have been erected in a number of locations in London and the south-east on lines affected by increased noise from channel tunnel trains. Voluntary jointly funded noise mitigation schemes were agreed between the British Railways Board, Railtrack and the local authorities concerned. Such noise barriers are, however, likely to remain the exception to the rule and I expect the railway industry to concentrate its efforts on reducing noise at source. New projects such as the CTRL have been very successful in incorporating noise mitigation measures in the design from the beginning.

Looking to the future, a general European Union noise directive is likely to be the main driver of tighter standards for railway and other noise across Europe. Hon Members may know that the EU published a Green Paper on future noise policy on 5 November 1996. The Commission proposes to establish a framework of working and steering groups to consider noise policy, which will include a railways working group.

I regret that the hon Gentleman's constituents are suffering from noise from the sidings in Guildford. The resignalling scheme that causes part of that noise is due to be completed by July 1999, but I hope that, before then, Railtrack will be able to find ways of reducing the disturbance to local residents. In the longer term, there is always likely to be some noise disturbance for those who live next to railway sidings, and I fear that little can be done about it.

Although railways are generally more environmentally friendly than roads – the Government want to see more use made of the railway network – I assure the hon Gentleman that the Government take the wider issue of railway noise very seriously and will be talking to the railway industry about what can be done to reduce noise at source. I must stress that there are no easy or cheap solutions.

The hon Gentleman raised three particular points. He said that the Rail Regulator should issue guidelines on the environment and that there should be consultation with residents, and he raised the issue of contractors. I

believe that Railtrack should be undertaking such things anyway. There should be no formal requirement concerning the regulator. Railtrack, in the main, exists only as a result of vast public subsidies, which go into our railways via access charges. It is surely in Railtrack's best interests, as a good private company that wishes, as it has said, to be a good neighbour, to ensure that the kind of actions that the hon Gentleman has proposed are part and parcel of its work in every way.

With regard to the possibility of a transport Act, we shall be publishing a White Paper on our integrated transport policy – how we can make best use of all transport modes, including roads, railways and waterways. I am not able to say that there will be a separate transport Bill, but as the hon Gentleman knows, we are looking at the creation of a strategic rail authority.

I am in no position to comment on – nor have any knowledge of – the possibility of a review of the Land Compensation Act. I have made a note of what the hon Gentleman said. His comments stem directly from his constituents' concerns about a particular incident, and I shall look further into the matter.

Report

International INCE Working Party: Upper Limits on Noise in the Workplace

Executive Summary

In the 1990s it has become widely recognized that the economic and social costs of high levels of noise in the workplace require significant action to reduce the exposure of workers to noise. Such costs include not only the financial compensation or damages that must be paid, and the reduced enjoyment of everyday life for those with a hearing loss, but also less quantifiable factors such as reduced productivity, increased stress, disturbed speech communication and risk of accidents for a large number of workers.

This International INCE Technical Assessment is presented in the form of a report that briefly reviews the extensive scientific and epidemiological evidence relating exposure to noise, including impulsive noise, and risk of hearing damage, and discusses the factors that are relevant to legislation. The basic features of existing legislation from many jurisdictions are tabulated. The setting of specific limits on exposure to noise is a political decision, with results that vary between jurisdictions depending on economic and sociological factors. It is however also important that regulations be harmonized internationally. The report therefore makes specific recommendations for legislation in the areas of daily exposure levels normalized to 8 hours, limitation of peak sound pressure levels for short-duration (impulsive) noises, acceptable sound pressure level changes for longer or shorter daily exposure periods, sound absorption in working areas, the inclusion of sound output requirements in purchase specifications for new machinery, the use of personal hearing protection, and audiometric testing.

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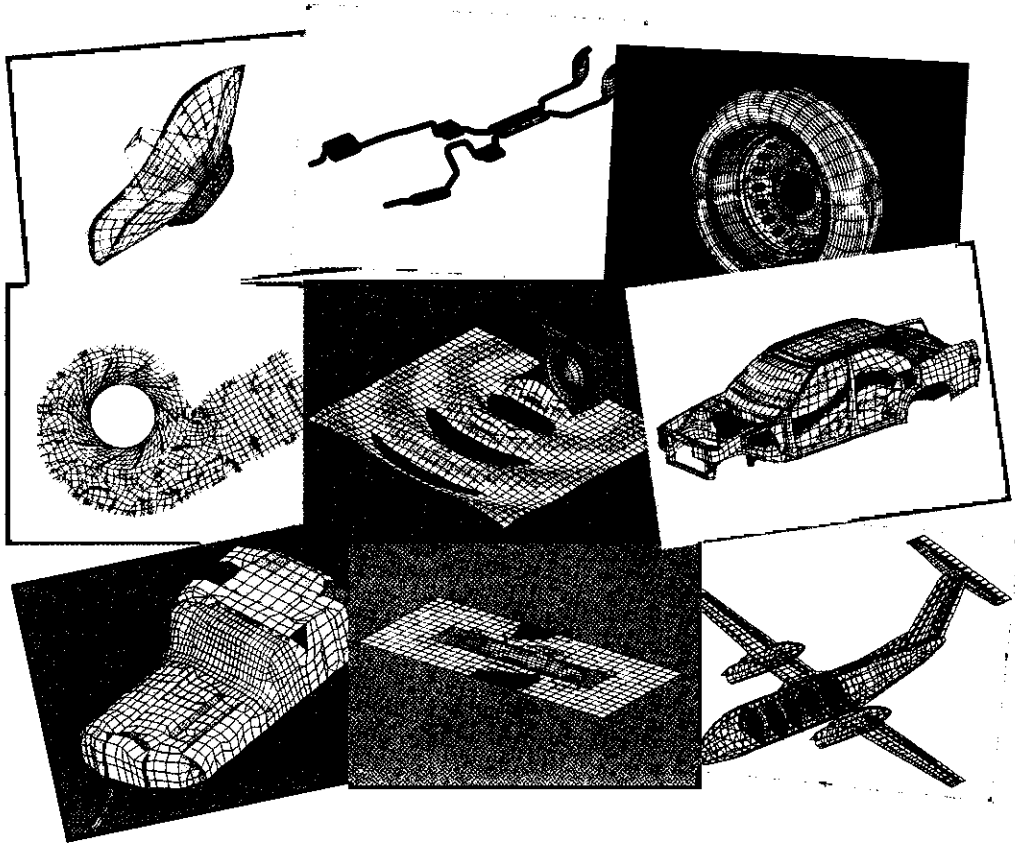

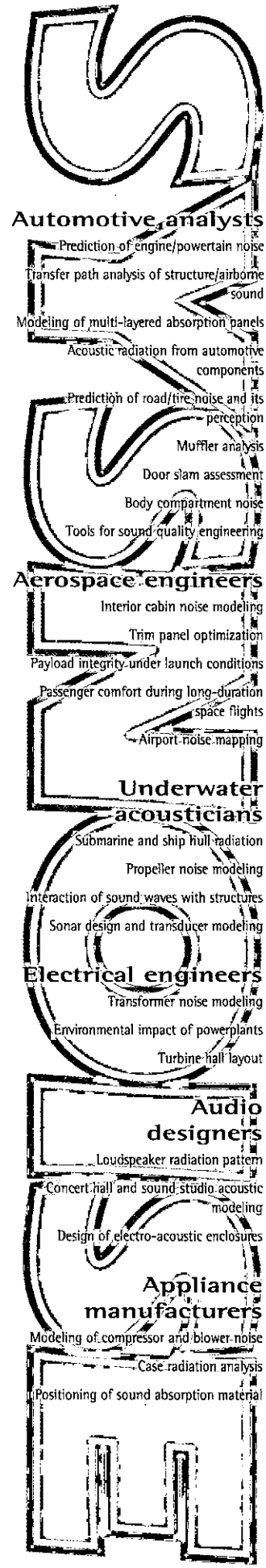

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Specific recommendations are:

1. It is desirable for jurisdictions without regulations, or with currently higher limits, to set a limit on the level of exposure over a workshift, A-weighted and normalized to 8 hours, of 85 dB as soon as may be possible given the particular economic and sociological factors that are pertinent;
2. This exposure level should include the contribution from all sounds that are present including short-term, high-intensity sounds. If such sounds are further limited in regulations to a maximum sound pressure level, then regulations should set a limit of 140 dB for C-weighted peak sound pressure level;
3. An exchange rate of 3 dB per doubling or halving of exposure time should be used. This exchange rate is implicit when the exposure level is stated in terms of 8-hour-average sound pressure level;
4. Efforts should be made to reduce levels of noise in the workplace to the lowest economically and technologically reasonable values, even when there may be no risk of long-term damage to hearing. Such action can reduce other negative effects of noise such as reduced productivity, stress and disturbed speech communication;
5. At the design stage of any new installation, consideration should be given to sound and vibration isolation between noisier and quieter areas of activity. Rooms normally occupied by people should have a significant amount of acoustical absorption in order to reduce the spatial distribution of sound;
6. The purchase specifications for all new and replacement machinery should contain clauses specifying the maximum emission sound power level and emission sound pressure level at the operator's position when the machinery is operating;
7. A long-term noise control program should be established and implemented at each workplace where the level of the daily exposure, normalized to 8 hours, exceeds 85 dB. This program should be reassessed periodically in order to exploit advances in noise-control technology;
8. The use of personal hearing protection, either earplugs or other hearing protection devices, should be encouraged when engineering and other noise control measures are unable to reduce the daily, normalized-to-8-hours, A-weighted exposure level of workers to 85 dB. The use of hearing protection devices should be mandatory when the exposure level is over 90 dB; and
9. All employers should conduct audiometric testing of workers exposed to more than 85 dB at least every three years, or at shorter intervals depending on current exposure levels and past history of the individual worker. Records of the results of the audiometric tests should be preserved in the employee's permanent file.

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The full text of the report, for which this is an executive summary, appears in Noise/News International

volume 5 number 4, December 1997 published by the International Institute of Noise Control Engineering, PO Box 3206, Arlington Branch, Poughkeepsie NY 12603–0206, USA Fax: +1 914 463 0201. The IOA office has a few copies of this issue for members to consult.

BSI News

BS EN Publications

BS EN 1793: Road traffic noise reducing devices – Test method for determining the acoustic performance.

BS EN 1793-1: 1998 Intrinsic characteristics of sound absorption. Specifies the laboratory method for measuring the sound absorption of flat noise barriers or flat cladding for retaining walls or tunnels. No current standard is superseded.

BS EN 1793-2: 1998 Intrinsic characteristics of airborne sound insulation. No current standard is superseded.

BS EN 1793-3: 1998 Normalized traffic noise spectrum. No current standard is superseded.

BS EN 60034: Rotating electrical machines.

BS EN 60034-9: 1998 ≡ IEC 60034-9:1997 Noise limits. Specifies maximum A-weighted sound power levels for factory acceptance testing. Excludes act motors supplied by convertors. Supersedes BS EN 60034-9: 1994.

BS EN 61237: Broadcast video tape recorders – Methods of measurement.

BS EN 61237-4: 1998 ≡ IEC 612374:1997 Analogue audio performance measurements. Describes methods of measurement and test signals for the analogue audio part of equipment for recording/reproduction of TV signals on magnetic tape reels or cassettes. No current standard is superseded.

British Standard Implementations

BS ISO 5805: 1997 Mechanical vibration and shock – Human exposure – Vocabulary. Defines terms relating to human biodynamics. No current standard is superseded.

Special Announcement

BS 5228-1: 1997 Noise and vibration control on construction and open sites – Part 1: Code of practice for basic information and procedures for noise and vibration control.

Two technical errors have been identified in the above British Standard. They are as follows:

In D.3.2.2.1, equation D.2: 'where $R \leq 25$ m' should read 'where $R \geq 25$ m'.

In D.3.2.2.1, equation D.3: should read

$'K_h' = (20 \log_{10} R) + 8 \quad (D.3)'$

and equation D.4 should read

$'K_s' = (25 \log_{10} R) + 1 \quad (D.4)$

where $R \geq 25$ m'

These, together with more recently available information on EC noise limits for earth-moving machinery, will be the subject of an amendment.

European New Work Started

EN 13023: Noise measurement methods for printing, paper converting, paper making machines and auxiliary equipment – Accuracy Categories 2 and 3.

Draft British Standards for Public Comment

98/100337 DC Amendment No. 1 to BS 52281: 1997 Noise and vibration control on construction and open sites – Part 1: Code of practice for basic information and procedures for noise and vibration control.

97/262149 DC Revision of IEC 60534-8-3 Industrial process control valves – Part 8: Noise considerations – Section 3: Control valve aerodynamic noise prediction method – Extension of aerodynamic noise method (Possible amendment to BS EN 60534-8-3) (IEC 65B/330/CD).

97/719446 DC EN 13023 Noise measurement methods for printing, paper converting, paper making machines and auxiliary equipment – Accuracy Categories 2 and 3 (prEN 13023).

97/720456 DC Revision of ISO 5349-1 Human exposure to mechanical vibration and shock (BS 6843: 1987 and DD ENV 25349 may be affected) (ISO/DIS 5349-1).

ISO Standards

ISO 5135: 1997 (Edition 2) Acoustics – Determination of sound power levels of noise from air-terminal units, dampers and valves by measurement in a reverberation room. Will be implemented as BS ISO 5135 superseding BS 47732: 1989.

ISO 13818-7: 1997 Advanced Audio Coding (AAC)

IEC Publications

IEC 60942: November 1997 (Edition 2) Electroacoustics – Sound calibrators.

This list was compiled from the January and February 1998 issues of BSI Update.

Book Review

Tuning, Timbre, Spectrum, Scale
William A Sethares
Springer 1997
paperback 352pp plus audio CD £29.50
ISBN 3-540-76173-X

This book is a journey into the fascinating world of xenharmonic music, that is, music not written for the twelve tone equal temperament (12-tet) scale of traditional Western music. The relationship between the timbre, and therefore spectrum, of sounds and a perception of consonance and dissonance is explored. A physical measure of consonance called sensory consonance is proposed and a computer algorithm termed the dissonance meter generates a plot of dissonance vs pitch interval for given spectra. Minima in the dissonance curve indicate where steps in the musical scale give notes that produce

consonance. The dissonance curve is used to examine historical and modern Western scales and, in contrast, those used in Indonesian and Thai music. Wind and stringed instruments have harmonic spectra and naturally produce dissonance curves that conform approximately to the 12-tet scale. The gongs and metallophones of the Gamelan have non-harmonic spectra that more naturally conform to 5-note and 7-note scales. Many other scales are described including 8-tet, 9-tet, 10-tet, 11-tet, 19-tet, scales with unequal steps such as Partch's 43 tone scale and scales that do not repeat at the normal octave ratio of 2:1.

Adaptive and dynamic tunings are described in which a computer algorithm allows the synthesizer to make small adjustments to the pitch of notes 'on the fly' resulting in a kind of just intonation without prior knowledge of key. Practical advice is given on how to generate new tunings and map them onto the synthesizer's keyboard. Spectra from some unusual sources, rocks and x-ray crystallography, are the basis of musical examples but the spectra from real instruments can be mapped onto non-harmonic spectra to give more natural sounds.

The 'dissonance score' is a way of analysing a musical performance and the author proposes a way of attempting to reconstruct historical tunings that have been lost, such as those used by the harpsichordist Scarlatti. The related, but more difficult problem, of generating 'suitable' spectra from specified scales is also discussed.

There is a comprehensive index and a discography of xenharmonic music. For readers who wish to pursue the subject the bibliography of 173 references provides a rich source, including many intriguing titles. 'Lies my music teacher told me' sounds wonderfully subversive. This bibliography also includes a useful short description of the content of each publication, something I have never seen before. Detailed mathematical analyses and descriptions are given in a series of appendices that includes computer program listings for the 'dissonance meter' in the BASIC and MATLAB languages. An accompanying CD provides short musical passages and demonstrations of many of the effects described.

The author's informal writing style (even jocular in places) makes the book easy to read. This book is obviously of use to experimental musicians and composers but it is so absorbing I recommend it to anyone with even a passing interest in acoustics and music.

Graham Rock MIOA ❖

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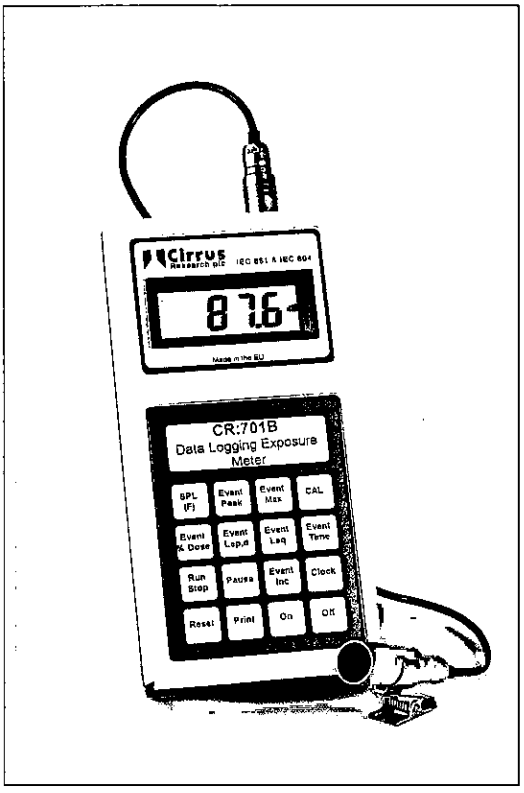
The CR:701 B is a new Personal Noise Dosemeter that is claimed to make measurements simple. It provides all of the measurements needed to comply with the Noise at Work regulations throughout the European Union.



The data logging instrument can store many different parameters such as Leq, Lep,d, % Dose and Peak(C) Levels. In addition, the unit can store a profile of the noise levels throughout the measurement period. All the information can be downloaded using the Windows software supplied as standard with the instrument.

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For more information contact The Noise Control Centre, Crown Business Park, Old Dalby, Melton Mowbray, Leics LE14 3NQ Tel: 01664 821810 Fax: 01664 821820, or visit the Building Services Exhibition at Earls Court, 12–14 May 1998.

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NEXUS - Signal Conditioning Amplifiers

Brüel & Kjær have also introduced NEXUS, a new range of four channel conditioning amplifiers, which cater for a wide range of uses in the sound and vibration industry.

NEXUS offers a dynamic range of up to 120 dB, advanced overload detection facilities and transducer tests. This provides the flexibility to make different measurements whatever the signal or measurement situation. An extensive array of built-in filters make it easy to focus on the signal of interest.

NEXUS can handle a variety of acoustic and vibration transducers. The NEXUS range can interface with five main types of transducers, microphones, a sound intensity probe, charge amplifiers, accelerometers with internal electronics and force transducers. The conditioning channels can be mixed and put in the same NEXUS 4 channel unit.

For further details contact Brüel & Kjær, Harrow Weald Lodge, 92 Uxbridge Road, Harrow, Middlesex HA3 6BZ Tel: 0181 954 2366 Fax: 0181 954 9504.

Brüel & Kjær is a Key Sponsor of the Institute.

NEWS ITEMS

OMETRON

Vibration analyser takes the ear out of speaker development

Although conceived as a development tool for automotive and aircraft designers, Ometron's VPI 4000 has been used by Mackie Designs, the US audio speaker company, in its acoustic laboratory as part of a development programme to find the ideal sound system.

Specialising in developing speakers for recording studios, Mackie Designs turned to the VPI 4000 for help in transforming its theoretical ideas for an active monitor – an internally-powered rather than a passive speaker – into a precise, powerful and completely neutral sound system.

Instead of employing the traditional highly subjective 'tweak and listen' approach to speaker design, Mackie development engineers used the VPI 4000's scanning laser vibrometry to give a clear picture of exactly what was happening on the surface of the speaker.

The VPI 4000 uses a low-power laser to scan the surface of a vibrating component from a range of a few millimetres up to 200 metres or more. It produces full-field vibration maps at selected frequencies within seconds through Fast Fourier Transform analysis of the surface data.

Vibrating surfaces can be unprepared and poor reflectors, and they can also be complex in shape.

For further information please contact Ometron Division, Image Automation Ltd, Kelvin House, Worsley Bridge Road, Sydenham, London SE26 5BX Tel: 0181 461 5566, Fax: 0181 698 3768 Email: ometron@image-main.ccmail.compuserve.com.

CEL INSTRUMENTS LTD

Additional Type Approvals For CEL-500 Sound Analysers

CEL Instruments announce that its CEL500 Series product line has again received Type Approval from the acknowledged leading international Physical Standards Institute, the German PTB.

PTB Type Approval was first granted in 1994 during its first year of production. Continued product development since then has introduced several new instrument-resident applications and made them available in five languages. In 1997 further development revised the electro-acoustic and memory specifications and the PTB determined that a re-verification of the original approval was required.

This process was completed in November 1997 and as a result, firmware version 6.3, which enables a back-lit display, 10 dB measurement range steps, 2 Mbyte high density data memory and resident multi-lingual firmware, is now approved for legal metrology use.

Although the UK does not currently require Type Approval for measurement products other than retail weighing and volume dispensing products (eg petrol pumps), many other countries mandate that any data used for assessing legal compliance is obtained with products which must pass a rigorous approval process.

Further information from CEL Instruments Ltd, 35–37 Bury Mead Road, Hitchin, Hertfordshire SG5 1RT, UK. Tel: 01462 422411 Fax: 01462 422511 or via Email: sales@cel.ltd.uk.

CEL Instruments is a Key Sponsor of the Institute.

MAIDSTONE'S CHEQUERS CENTRE

Henry Venables Ceiling

Henry Venables of Stafford was approached to help with a project at the Chequers Shopping Centre, Maidstone, part of which houses a bus station.

A 'wave form' ceiling made of douglas fir was suspended from the bare concrete roof (the underside of the shopping centre) to provide a pleasant visual amenity. To dampen the intrusive sound of revving bus-engines, the curved ceiling was designed with acoustic properties, and acoustic foam panels were

installed in the coffers above the bus lanes.

Henry Venables was contracted to detail the ceilings using its acoustic profile, Profilia P2, pre-treated with Hickson's Dri-con fire retardant. This was essential to achieving a class '0' fire rating to the waiting area, and a class '1' rating to the rest.

For further information contact Henry Venables Ltd, Castletown, Stafford ST16 2EN Tel: 01785 259131 Fax: 01785 215087 email enquiries@henryvenables.co.uk.

N+H ACOUSTICS

New Identity

G+H Montage Acoustics has announced the launch of its new identity under the name N+H Acoustics Ltd within the SGE Group of companies.

Launched as the Acoustical Solution Provider, N+H Acoustics Ltd have a wealth of expertise and experience in industrial and environmental acoustics, servicing the industrial, workplace building service, retail and refrigeration markets. Bespoke design solutions are also supported by the trade name and range of PAR acoustic products.

For further information contact N+H Acoustics Ltd, Environmental House, 38 Station Road, Wokingham, Berkshire RG40 2AE Tel: 0118 978 5265 Fax: 0118 978 5290.

CIRRUS RESEARCH PLC

Noise Monitoring at Sheffield City Airport

Cirrus Research announce the supply of an Airport Noise Monitoring System to the new Sheffield City Airport, where first commercial flights started on 16 February 1998.. The equipment includes two CR:245/3 Environmental Noise Analysers along with download and analysis software.

In order to meet operating conditions, the airport must monitor and, where necessary, regulate the noise levels generated by aircraft using the runway. The CR:245/3 has been configured to meet these monitoring requirements, whilst also having all of the measurement functions that the airport will need when the number of daily flights increases.

In addition to these two instruments, the Airport is also using handheld CR:703B Data Logging Sound Level Meter which is used for quick measurements at different locations around the site.

Further information contact Tel: +44 (0)1723 891655 Fax: +44(0)1723 891742

Items for inclusion in this section should be sent to John Sargent MIOA, Oak tree House, 26 Stratford Way, Watford WD1 3DJ ❖

Institute of Acoustics

BUYER'S GUIDE
FOR
ACOUSTIC MEASUREMENT INSTRUMENTATION & ACOUSTIC PRODUCTS

The Institute of Acoustics intends to publish a **Buyer's Guide for Acoustic Measurement Instrumentation and Acoustic Products** in early November this year.

The first edition, of what is expected to be an annual publication, will be approximately 100 to 120 pages in length and will be free to all members of the Institute of Acoustics. It will also be available to members of the public or other organisations who contact the Institute office for assistance regarding the possible purchase of acoustic measurement instrumentation or other acoustic products.

The Buyer's Guide is intended to be as comprehensive a document as possible and will be divided into three sections with the first two listing some 118 categories of acoustic measurement instrumentation or other acoustic products, many of which will be sub-divided into more detailed listings. Each category or subdivision will be identified numerically. The third section will provide the details of the addresses etc of the manufacturers or suppliers of the various items listed in the first two sections, with the numerical identification being used to provide a cross referencing system. This will enable a reader not only to identify and contact a firm from the numerical identification, but also to find out what other instruments or products a firm may market without reading through the whole publication.

An entry fee of £100 plus VAT will be levied per company address for companies wishing to participate in the publication.

For further information, please contact:

Keith Rose, Associate Editor, Brook Cottage, Royston Lane, Comberton, Cambs, CB3 7EE
Tel: 01223 263800 Fax: 01223 264827

NOISE FROM PUBS AND CLUBS: A CALL FOR HELP!

In 1996 the Institute of Acoustics set up a working group of volunteers from local authorities and noise consultancies with a brief to produce a code of practice on the control of noise from pubs and clubs.

At an early stage the group decided that, where practical, the code should contain prescriptive limits for noise arising from such sources as garden play areas; rowdy behaviour, car parks, but in particular amplified and non-amplified music. However, one of the conclusions resulting from the group's deliberations is that there is a distinct lack of authenticated research into the effects of environmental noise from pubs and clubs on nearby residents. Therefore the group has come up with some 'limits' derived from individual members' experiences in dealing with noise problems from pubs and clubs coupled with the collective application of some common sense.

The group's original intention was to carry out trials of these limits (so-called 'trials of the numbers') with the help of local authorities and noise consultancies in the Spring/Summer of 1997. However, at that time the entertainment trade expressed interest in the work of the group and as a result the trial was postponed and five representatives of the trade joined the working group. The reconstituted group is now ready to proceed with the trial which will last from 1 April to 1 September 1998. That is where you come in. Can you participate in the trial? It will involve a little extra noise measurement work when you are investigating complaints, planning applications and licence applications and renewals.

If you or your organisation are interested, please contact the working group secretary, Dawn Connor on Tel 01256 845520 and she will send you an information pack.

Thanking you in anticipation of your help.

John Hinton, Chairman of the IOA Noise from Pubs and Clubs Working Group

Non-Institute Meetings

April 5–8, 1998: Noise-Con 98, Ypsilanti, MI, USA
Contact: INCE, PO Box 3206, Arlington Branch, Poughkeepsie, NY 12603, USA; Fax: +1 914 462 4006; e-mail: inceusa@aol.com

May 12–15, 1998: IEEE International Conference on Acoustics, Speech and Signal Processing, Seattle, WA, USA
Contact: L Atlas, Dept EE (FT 10), Univ of Washington, Seattle, WA, USA; Fax: +1 206 543 3842; e-mail: atlas@ee.washington.edu

May 25–27, 1998: Noise and Planning 98, Naples, Italy
Contact: Noise and Planning, via Bragadino 2, I-20144 Milano, Italy; Fax: +39 2 48 01 88 39; e-mail: md1467@mclink.it

June 8–10, 1998: Joint EAA/EEAA Symposium Transport Noise and Vibration, Tallinn, Estonia
Contact: East-European Acoustical Association, 196158, Moskovskoe shosse 44, St Petersburg, Russia; Fax: +7 812 12 79 323; e-mail: krylspb@sovam.com

June 20–26,1998: Joint Meeting of the 16th International Congress on Acoustics (ICA) and the 135th Meeting of the Acoustical Society of America (ASA), Seattle, Washington, USA
Contact: ICA/ASA '98 Secretariat, Applied Physics Laboratory, Univ of Washington, 1013 NE 40th Street, Seattle, WA 98105-6698, USA; Tel: +1 206 543-1275, Fax: +1 206 543 6785, E-mail: ICA/ASA98@apl.washington.edu

June 26–July 1, 1998: International Symposium on Musical Acoustics – ISMA 98, Leavenworth, Washington State, USA
Contact: ISMA 98 Secretariat; The Catgut Acoustical Society; 112 Essex Av, Montclair, NJ 07042, USA; Tel: +1 201 744 4029 (Thursday only); Fax: +1 201 744 9197 e-mail: catgutas@msn.com; http://www.boystown.org/isma98

September 7–9, 1998: Nordic Acoustical Meeting 98, Stockholm, Sweden
Contact: Swedish Acoustical Society, c/o Ingemansson AB, Box 47321; S-10074 Stockholm, Sweden; Fax: +46 818 2678; e-mail: nam98@ingemansson.se

October 12–16, 1998: 136th Meeting of the Acoustical Society of America, Norfolk, VA, USA
Contact: Elaine Moran, ASA, 500 Sunnyside Blvd, Woodbury, NY 11797 USA; Fax: +1 516 576 2377; e-mail: asa@aip.org

November 16–18, 1998: Inter-Noise 98, Christchurch, New Zealand
Contact: New Zealand Acoustical Society Inc, PO Box 1181, Auckland, New Zealand

November 20, 1998: Recreational Noise, Queenstown, New Zealand (In association with the above)
Contact: P Dickenson, Ministry of Health, PO Box 5013, Wellington, New Zealand, Fax: +64 4 496 2340; e-mail: philip.dickenson@mohwn.synet.net.nz