THE BULLETIN

OF THE
AUSTRALIAN ACOUSTICAL SOCIETY

Volume 4, Number 3, September 1976

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THE BULLETIN

OF THE
AUSTRALIAN ACOUSTICAL SOCIETY

VOLUME 4, NUMBER 3
SEPTEMBER 1976

GUEST EDITORIAL

HEARING CONSERVATION REGULATIONS

In view of the deterioration in hearing caused by noise in work situations for many years there is an obvious need for some control.

The responsibility for preventing deafness should be shared by those who create the risk and those who work in it. The employer must determine if there are exposures in excess of those prescribed and, if so, he must be responsible for taking precautions to prevent excess exposures unless he has been exempted by the authority. The employee has a responsibility to ensure that silencing equipment is correctly used and that protective devices are worn when required.

Noise-induced deafness is a human problem which concerns people at work. It will only be solved when the people directly affected are informed of a clearly defined company policy on hearing conservation and when such employees are involved in joint consultation with management. Not only will this consultation provide valuable practical information for the solution of the problems, such as compatability between operational and acoustic requirements, but, if employees are consulted, and are part of the decision, they are far more likely to co-operate with the whole program.

The involvement of employees does not mean 'worker control' in the sense feared by some managers. It means consultation with employees who are part of the work team, an important point which is too frequently overlooked at senior levels of management. A regulation may not tell an employer that he shall consult with an employee. However, it can require him to supply the employees, or their representative with a copy of certain statements, such as an application to the regulating authority for exemption from some part of the regulations. In this way the employee will be brought into discussion with the employer. Progressive managements, of course, realise the value of such discussions. If an employee is to operate a new machine it is reasonable to include him in discussions prior to the purchase of a machine in excess of a prescribed noise level.

Regulations cannot be discussed without reference to measurement of noise. Major areas for measurement (where measurements can and should be precise) are in the design of quieter equipment, in planning to reduce noise exposure and particularly in determination of noise emissions to compare machines under specific operating conditions.

The Standards Association of Australia has made a most valuable contribution in preparing a Standard Method of Measurement of Noise from Agricultural Tractors and Earthmoving Equipment. There is need for the preparation of further similar standards for the measurement of noise emission from specified machines. A Standard is not legislation, but it can considerably assist in legislation. Accurate methods of comparing sources of noise will play a major role in future regulations and in ultimately reducing the noise from machines and the consequent risk of deafness.

Owing to variations in levels, durations and types of noises, measurements to determine noise exposure in work situations still present difficulties. The prescribed figure for the introduction of regulations in N.S.W. and in other States is likely to be based on recommendations of the National Health and Medical Research Council of Australia, i.e., a Daily Noise Index of 1.0 (equivalent to 90 dBA for 8 hours). Whilst the above level has been recommended as a starting point it is well known that there is still a considerable risk of deafness and that further reduction is desirable.

The National Health and Medical Research Council has therefore recommended a lower figure for new plant and a progressive reduction over a period of time to 0.33 Daily Noise Index (equivalent to 85 dBA for 8 hours). Whether all States include this provision in regulations initially, or not, it is feasible to predict that this figure will eventually apply. I firmly consider that the inclusion of such a provision is essential as an incentive to equipment manufacturers and to industry generally and as a guide for their future planning.

Industries should not despair because they cannot achieve a prescribed figure immediately. Contemplated regulations will provide for exemptions subject to conditions and such exemption would require the introduction of an alternative hearing protection program (i.e. involving the use of personal hearing protectors). An employer will, of course, be expected to first examine practical means of noise reduction.

If granted an exemption, as part of the alternative hearing protection program, the employer will be required to supply hearing protective devices suitable for the particular circumstances and the employer will be required to use that device. How far this latter requirement might be enforced and whether a prosecution under it is likely remains to be seen, but such a provision is necessary.

The use of audiometry is controversial and there is, of course, the opposition based on fears of an increase in compensation claims for noise-induced deafness. (Regulations must require that both the employee and the employer be given a copy of the audiogram). There are difficulties, such as the need for 'quiet' test conditions and precautions to avoid errors resulting from a temporary noise-induced threshold shift.

However, as there are many work situations where an accurate determination of noise exposure is difficult, if not impossible, and there are variations in the effectiveness of hearing protection for a number of reasons, audiometry is essential in regulations as a means of evaluating the program. When the loss of hearing exceeds prescribed figures, such as those recommended by the N.H. & M.R.C. the employer should appraise the programme to find out the reasons.

There is some confusion between regulations for hearing conservation and workers compensation claims for deafness. Some employers strive for higher prescribed noise exposures in the mistaken belief that it will protect them from having to pay compensation to employees working within such exposures. Although economics and practicability must be considered in deciding prescribed noise exposures for regulations, if an employee suffers noise-induced deafness as a result of his occupation he will be entitled to payment, irrespective of the level prescribed in regulations.

HORRIE WESTON

SUSTAINING MEMBERS

OF THE AUSTRALIAN ACOUSTICAL SOCIETY

The Society values greatly the support given by the Sustaining Members listed below and invites enquiries regarding Sustaining Membership from other individuals or corporations who are interested in the welfare of the Society. Any person or corporation contributing $160.00 or more annually may be elected a Sustaining Member of the Society. Enquiries regarding membership may be made to The Secretary, Australian Acoustical Society, Science House, 157 Gloucester Street, Sydney, NSW, 2000.

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THE BULLETIN
OF THE AUSTRALIAN ACOUSTICAL SOCIETY

Volume 4, Number 3, September 1976

– *The Bulletin is published quarterly by the Australian Acoustical Society, Science House, 157 Gloucester Street, Sydney, NSW, 2000*

FROM THE PRESIDENT

Although Australia's noise legislation is still in the early stages of development, a number of acts and regulations have been passed by State governments, and some have already come up for revision. As the legislation continues to develop, several important questions will require answers.

One of the most urgent of these questions is whether adequate facilities will be available for effective enforcement. So far, the setting of noise standards has tended to be done with insufficient consideration of this matter. This requires immediate attention by the legislators. Nowadays in America, detailed analyses of the facilities necessary for enforcement and the costs of providing such facilities are usually carried out and the results taken into account in setting noise standards.

A second question is whether the legislation will receive public support. To assist in gaining this, it seems desirable for the legislation to include two things: firstly, a preamble giving the Government's policy and legislation's purpose so that the public is better informed on what the legislation seeks to achieve; and secondly, a statement of the likely future, as well as the present noise standards so that the manufacturer and consumer are provided with lead-times for further compliance. Present legislation in Japan includes current, future and "ultimate" noise emission standards for a variety of sources and these are reviewed periodically.

A third question is whether there should be National, as distinct from State, legislation. It appears that if constraints on trade between the States owing to differing noise emission requirements are to be minimised then appropriate National legislation should be enacted. On the other hand, the prime responsibility for community noise legislation may be better left with State and local governments, as is the case in America. This is because the States, and areas within them, will have certain individual requirements; for example, in relation to predominant noise sources, climatic conditions and availability of finance for enforcement.

The last of the four questions is whether the legislation will contain sufficient provisions to control potential, as well as present, noise nuisance. While it is important to provide for remedy against existing nuisance, this is a "postfix" approach to noise control, as nuisance has to occur before action can be taken. It is more important for the legislation to provide for and emphasise prevention so that nuisance can be anticipated and measures taken to control or minimise it before it occurs.

(Carolyn Mather)
PRESIDENT

NEWS & NOTES

UNIVERSITY OF NEW SOUTH WALES MASTER OF SCIENCE (ACOUSTICS)

The two-year part-time course leading to the degree of Master of Science (Acoustics) will commence again in Session One, 1977.

Acoustics is a rapidly growing field as a result of the introduction of noise control legislation in Australia and in many overseas countries. In addition increased attention is being paid to the acoustic requirements of venues for the performing arts as well as those of domestic, educational, industrial, commercial and public buildings.

The course provides for post-graduate study in several important topics in acoustics including noise control in the community, in industry and in buildings generally as well as auditorium design and advanced physical acoustics.

The course is designed for graduates in architecture, engineering or science, but candidates for admission are considered individually. Graduates of the course may seek employment in industry, research establishments, noise control authorities and other government bodies or may practice as acoustical consultants.

Conduct of the course is the responsibility of the School of Architecture with the assistance of senior academics of the Schools of Physics and Mechanical and Industrial Engineering.

Enquiries concerning the course should be addressed to the Dean, Faculty of Architecture, P.O. Box 1 Kensington, N.S.W. 2033. Telephone – 663-0351. Applicants for admission should be lodged immediately with the Registrar, University of N.S.W. at the above address.

AUSTRALIAN INSTITUTE OF PHYSICS ARCHIVE

The Australian Institute of Physics Archive was established in 1972 for the preservation of items of historical value relating to the history of physics and physicists in Australia.

The Archive is housed in the Adolph Basser Library, Canberra, by courtesy of the Australian Academy of Science. The Basser Library serves as a centre for the study of science in this country. Its purpose is two-fold. Firstly, it is a specialist library of published material relating to the history of Australian science, including Australian scientific publications. Secondly, it collects and preserves archival material and records the whereabouts of such material.

Archival material may consist of such things as draft manuscripts, laboratory day-books, field notes, notes of experiments, personal diaries, letters, photographs, autobiographical notes, memoirs, minutes of meetings, unpublished reports, etc. The Basser Library has professional staff to advise on the suitability of material and the best form and location for its storage.

The Basser Library also maintains an Australia-wide catalogue of scientific manuscripts preserved by other libraries and institutions together with a biographical card index of Australian scientists from early settlement to the present day. It publishes *Records of the Australian Academy of Science* as well as reports and articles based on historical material.

The Australian Institute of Physics wishes to encourage physicists to help in tracing potential archival material and to make this available for permanent storage and future reference. Contributions and enquiries may be directed to

AIP ARCHIVE,
c/- The Librarian,
Adolph Basser Library,
Box 216, Civic Square,
Canberra, ACT 2608

BACK NUMBER SALE – JASA, NOISE CONTROL, AND SOUND

In order to reduce storage costs, the Executive Council of the Acoustical Society of America has voted to reduce substantially the inventory of back issues of JASA. Before disposing of the oversupply of back numbers, however, the issues listed below will be made available to members at $4 each (regular price is $7) or $3 each for quantities of 10 or more issues.

JASA 1947 to 1960
Vol 19 through Vol. 32 – except Vol. 32, #4 and #5
JASA 1965 to 1970
Vol. 37 through Vol. 48
JASA 1972 to 1975
Vol. 51 through Vol. 58 – except Vol. 54, #1, #2, and #3

Some of the special issues included in the above are:

Von Bekesy issue – Vol. 34, No. 9, Pt. 2
Mason issue – Vol. 41, No. 4, Pt. 2
Hunt issue – Vol. 57, No. 6, Pt. 1
First Sonic Boom Symposium – Vol. 39, No. 5, Pt. 2
Second Sonic Boom Symposium – Vol. 51, No. 2, Pt. 3

In addition, the following volumes of NOISE CONTROL and SOUND are available by complete volume only (6 issues) at $15 per volume:

NOISE CONTROL – Vols. 1 through 7, 1955-1961
SOUND – Vols. 1 and 2, 1962-1963.

Orders must be prepaid and should be addressed to B. H. Goodfriend, Acoustical Society of America, 335 East 45 Street, New York, N.Y. 10017. The deadline is 31 December 1976.

CODE OF ETHICS

Pending the production of a code by the Australian Acoustical Society, the Ethics and Practice Committee has recommended use of the 'Code of Ethics' approved by the Council of The Institution of Engineers under By-Law 96, effective from 30th June, 1966.

This recommendation was adopted by the AAS

Federal Council at its 8th Meeting and was reaffirmed at the 15th Meeting in February, 1976. The Code of Ethics is reproduced below.

PREAMBLE

The further development of civilisation, the conservation and application of natural resources, and the improvement of the standards of living of mankind depend largely upon the work of the Engineer. For that work to be fully effective, it is necessary not only that Engineers strive constantly to widen their knowledge and improve their skill but also that the community avail itself of the assistance that Engineers can give and that it be able to place its trust unreservedly in the integrity and judgement of the Profession.

It therefore behoves all Engineers, and members of The Institution in particular, so to order their lives and work as to merit and gain this confidence.

To this end all members of The Institution are enjoined to conform with the letter and the spirit of the Code of Ethics set out hereunder and, in addition, to comport themselves at all times with such dignity and propriety as will earn for the Profession the respect of the community.

CODE

Duty to Community

1. An engineer's responsibility to the community shall at all times come before his responsibility to the Profession, to sectional or private interests, or to other Engineers.

Matters of Fact

2. If called upon to give evidence or otherwise to speak on a matter of fact, he shall speak what he believes to be the truth, irrespective of its effect on his own interests, the interests of other Engineers, or other sectional interests.

Matters of Opinion

3. Unless he is convinced that his duty to the community compels him so to do, he shall not express opinions which reflect on the ability or integrity of another Engineer.

Intra-Professional Courtesy

4. He shall neither maliciously nor carelessly do anything likely to injure, directly or indirectly, the reputation, prospects or business of another Engineer.

Unfair Advantage

5. He shall not use the advantages of a salaried position to compete unfairly with Engineers in private practice, nor use unfairly the advantages of private practice to the detriment of salaried engineers.

Diligence

6. In whatever capacity he is engaged, he shall assiduously apply his skill and knowledge in the interests of his employer or client.

Limitations

7. If he is confronted by a problem which calls for knowledge and experience which he does not possess, he shall not hesitate to inform his client or employer of the fact, and shall make an appropriate recommendation as to the desirability of obtaining further advice.

Training of subordinates

8. When in a position of authority over other Engineers, he shall take every care to afford to those under his direction every reasonable opportunity to advance their knowledge and experience.

Credit to Subordinates

9. He shall ensure that proper credit is given to any subordinate who has contributed in any material way to work for which he is responsible.

Acceptance of Favours

10. He shall at all times avoid placing himself under any obligation to any person or firm in whose dealings with his employer or client he may be concerned. If such an obligation exists he shall fully disclose the fact to his employer or client. He shall not accept any substantial gift or favour from such person or firm.

Financial Interests

11. If he has any substantial financial interest in any firm or company that may tender or contract for the construction of, or the supply of, any materials or equipment for any works for which he is in any degree responsible, or if he is entitled to any patent royalty or gratuity in respect of any equipment or process likely to be used in connection with such works, he shall fully disclose in writing the circumstances to his employer or client.

He shall not report upon or make recommendations on any tender from a company or firm in which he has any substantial financial interest or on tenders which include such a tender.

Confidential Information

12. He shall not use for his personal gain or advantage, nor shall he disclose, any confidential information which he may acquire as a result of special opportunities arising out of work done for his client or employer.

Contract Preparation and Supervision

13. In the preparation of plans, specifications and contract documents, and on the supervision of construction work, he shall assiduously watch and conserve the interests of his client or employer. However, in the interpretation of contract documents, he shall maintain an attitude of scrupulous impartiality as between his client or employer, on the one hand, and the contractor on the other, and shall, as far as he can, ensure that each party to the contract shall discharge his respective duties and enjoy his respective rights as set down in the contract agreement.

Consulting Practice

14. He shall not describe himself, nor permit himself to be described, nor act as a Consulting Engineer unless he is a Corporate Member and occupies a position of professional independence and is prepared to design and supervise the construction of engineering work and/or to act as an unbiased and independent adviser on engineering matters, and unless he conducts his practice in strict compliance with the conditions approved by the Council of The Institution.

Business Interests

15. If he is a Director or employee of any Company that offers Consulting Engineering Services in a manner and/or

on terms other than those approved by the Council of The Institution for a Consulting Engineer he shall not permit his name to be used in any advertisement of such services.

Soliciting Work

16. A Consulting Engineer shall not solicit professional work, either directly or indirectly, or by an agent, nor shall he reward any person who may introduce clients to him.

Advertisements

17. A Consulting Engineer may publish notices or professional cards, permit the display of his name on works under construction and on commemorative tablets and prepare brochures giving details of his practice provided that all published matter shall be in accordance with conditions approved by the Council of The Institution.

Replies to Advertisements

18. A Consulting Engineer may reply to advertisements or circular letters inviting applications for appointment provided that he does so in accordance with conditions approved by the Council of The Institution.

Continuance of Partnership

19. No member shall continue in partnership with, nor shall he act in association or conjunction with, any Engineer who has been removed from membership of The Institution because of unprofessional conduct.

LETTERS

INTERSTATE CO-ORDINATION OF LEGISLATION

Dear Sirs,

I refer to the editorial entitled "Federalism and Acoustics" by Mr. E. T. Weston published in the June 1976 edition of the Bulletin. As the editorial gave the impression that insufficient is being done to standardize noise control legislation on a nation-wide basis I thought that your readers should be made aware of the steps which have been taken towards this end by the agencies responsible for the preparation of noise control legislation in Australia.

A committee designated the Interstate Noise Control Liaison Committee has been formed on which the agency taking primary responsibility for the preparation of noise control legislation in each State is represented. The agencies represented are as follows:

NSW – State Pollution Control Commission.
QLD – Co-ordinator General's Department
SA – Department of Public Health
TAS – Department of the Environment
VIC – Environment Protection Authority
WA – Department of Public Health

Discussions have recently taken place with officers of the Department of Capital Territories with the view to the possible representation of the A.C.T. on the committee.

The main aim of this Committee is to achieve uniform noise control legislation throughout Australia. Secondary aims include the minimization of duplication of effort by the various States in the preparation of noise control legislation, the sharing of technical information on noise annoyance and noise control, and where appropriate the co-ordination of an Australia-wide programme for noise control.

To date four meetings of the Committee have been held and very satisfactory progress has been made.

I should perhaps emphasize that the terms of reference of the committee cover at present only environmental noise control and not occupational noise control.

If you feel that further information on the activities of this Committee would be of interest to your readers, I would be happy to raise the matter at the next meeting of the Committee with a view to preparing a summary of Committee activities.

R. Snow,
Chief Noise Control Officer,
Environmental Protection Authority
of Victoria,
P.O. Box 41, East Melbourne,
Victoria 3002.
(13th September, 1976)

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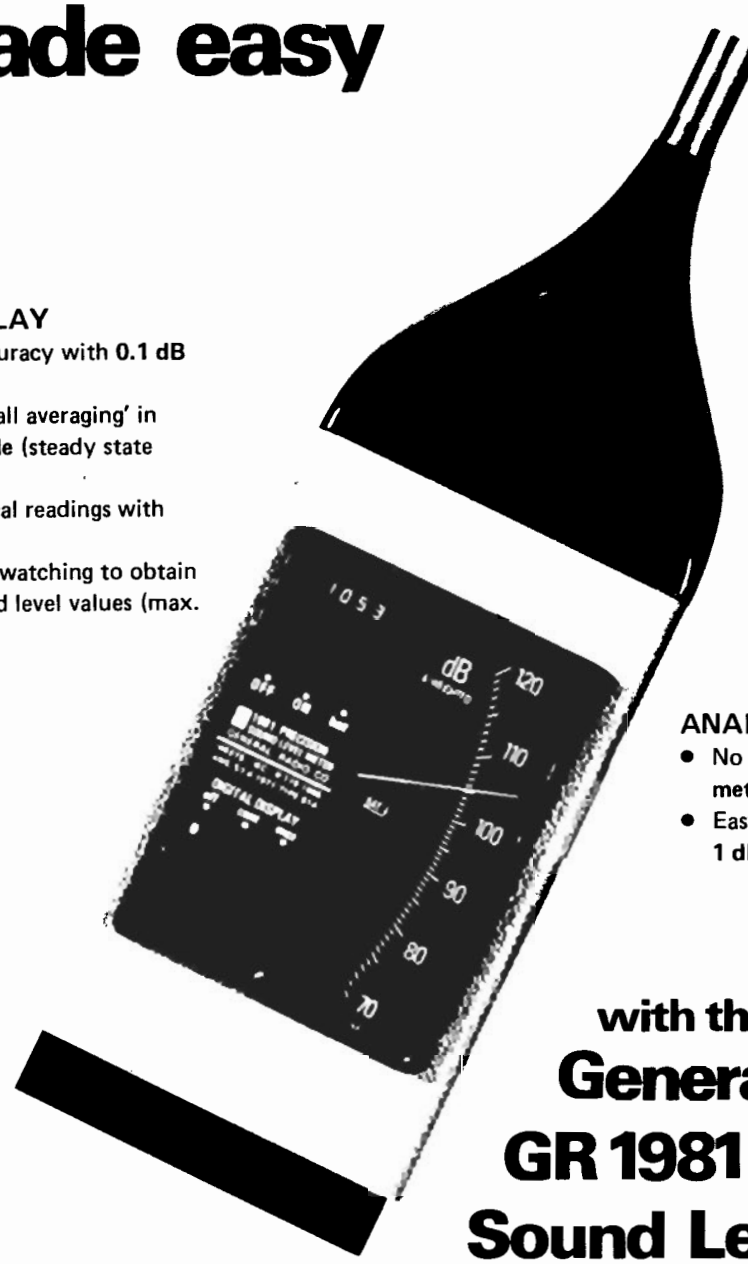

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TECHNICAL NOTE

THE DIDGERIDOO

John A. Moffatt

The following technical note is a brief report of a talk and demonstration presented to members of the Victorian Division by Trevor Jones on 7th November, 1975.

Trevor Jones is Professor of Music at Monash University. His interest in Aboriginal music and didgeridoos has extended over many years, and ten years ago, he addressed us on the subject "The Didgeridoo – an Acoustical Puzzle". It is now not so much of a puzzle, but some mystery remains.

The didgeridoo starts its life as a tree in Northern Australia, where termites are very active. Aborigines wanting a didgeridoo, tap each likely tree as they pass, listening for the characteristic sound of one which has been extensively hollowed by termites. The tree is cut down and trimmed externally, the bore is cleared out, and a didgeridoo has been made. They can be various sizes, and the bore may range from roughly cylindrical to roughly tapered.

Although it is wooden, it can be classed as a brass instrument because, like more modern orchestral brass instruments, it has no reed or whistle of its own, but relies on the player's lips to generate the basic sound. Not all "brass" instruments are made of brass now, and not all "woodwinds" are made of wood, but the terms are retained.

As with "brass" instruments it sounds its fundamental note when the players lips are loose and the wind pressure is low, and sounds overtones as the lip tension and wind pressure increase. There is however, no nicely shaped mouthpiece, no end bell and no nice clean bore, but there is a lot of air to be vibrated with relatively poor energy coupling to the player and to the outside. The effort required to play it is therefore rather great, and the shape and colour of the player's face changes as he strives for high notes or complex effects.

The bore shape of most didgeridoos is a slender truncated cone. The notes produced (i.e., the notes which are strongly reinforced are not the same as those produced by either a cylinder or a non-truncated cone. The first overtone occurs at about a frequence ratio of $^5/_2$ above the fundamental, whereas a cylinder gives a ratio of $^6/_8$ and a complete cone gives a ratio of $^4/_2$. The other overtones also do not conform to the regular series of odd harmonies for a cylinder and all harmonies for a cone.

Helmholz, in "Die Lehre von den Tonempfindungen", developed an equation for the notes of a truncated cone and found that it sounded as a stopped pipe of the same length for its higher tones and, at the lower tones, like an open pipe of length equal to the cone form which the truncated cone was taken. A test verified this except that the fundamental calculated tone was not observed. An American, Benade, has recently written about a series of privileged notes of brass instruments. These are notes which are reinforced but are not members of the harmonic series 1, 2, 3, 4 ... expected of conical tubes. [Brass instruments are generally not true cones anyway.] The mystery is not yet solved.

So much for the physics. Trevor then played the didgeridoo, and made most fascinating sounds. He showed how a combination of a note sung through the instrument, while it was being blown, could enhance the richness of sound by adding combination tones and beats, and how the Aborigines produce complex patterns by singing various notes, playing fundamental or overtone, and tapping the instrument with a stick. We were instantly transported to Arhnem Land. Most of the sounds were quite terrible, judged by our musical standards, and no doubt our harmonious music would bore or annoy an Aborigine. Indeed, if a didgeridoo has a fairly cylindrical bore, such that the first overtone is a harmonic of the fundamental, the Aborigine does not play the overtone.

The didgeridoo is quite a remarkable instrument compared with other primitive ones, and the virtuosity of the Aborigine is also remarkable compared with other primitive musicians.

BULLETIN PUBLICATION DEADLINES

Members and persons interested in the Society and Acoustics are invited to submit items for publication in forthcoming Bulletins: technical articles, shorter technical notes, brief reports on current research, news of members' and Divisions' activities, letters, or any items of general interest to members.

All submissions for publication should be clearly legible, and preferably typed with 1½ spacing. Apart from Technical Papers there are no special requirements for the format or presentation of items submitted for publication.

Technical papers (articles on technical topics exceeding about 2000 words) should be typed with 1½ spacing, and include a summary of approximately 150 words. Relevant information about the author should also be provided (approximately 100 words).

Contributions should be forwarded to 'The Bulletin of the Australian Acoustical Society, Science House, 157 Gloucester Street, Sydney, 2000".

Acceptance deadlines for publication are as follows:

Volume 4, Number 4, December 1976	
Full Technical Papers	5th November
Other Shorter Items	26th November
Volume 5, Number 1, June 1977	
Full Technical Papers	4th February
Other Shorter Items	18th February

CONFERENCE & SYMPOSIUM ANNOUNCEMENTS

ADVANCE NOTICE — 1977 AAS CONFERENCE

The Australian Acoustical Society's Annual Conference will be held in Perth, W.A., on Monday and Tuesday, 29th and 30th August, 1977. The Conference is jointly sponsored by the AAS and the W.A. Division of the Institution of Engineers, Australia.

The theme of the Conference will be 'Noise and Vibration in Industry'. A detailed program of topics and call for papers will appear in future issues of The Bulletin. Preliminary information may be obtained by contacting Graeme Yates, Department of Physiology, University of W.A., Nedlands, W.A., 6009.

9th ICA — MADRID, JULY 1977

Theme: Acoustics and Habitat
Planning the acoustic environment.

Circular 3 is now available, and the information it contains is outlined below:

(i) Invited Speakers to the Congress are:
- Lara (Spain) — Acoustic and Habitat
- Benade (USA) — Musical Acoustics Today: A Scientific Crossroads
- Brekhovskikh (USSR) — The Ocean as an Acoustical Medium
- Evans (UK) — Interaction Between Physiology and Psychophysics in Acoustics
- Fuchs (Argentina) — Objective and Subjective Acoustic, Evaluation of Rooms
- Fujisoki (Japan) — Speech Information Processing by Man and Machine
- Heckl (BRD) — Application of Energy Considerations for Solving Structural Problems
- Schultz (USA) — Noise Control in Buildings, codes Europe and USA
- Wertenvelt (USA) — Nonlinear Acoustics: Theory and Applications
- Zwicker (BRD) — Recent Developments in Psychoacoustics

(ii) Classifications for Contributed Papers are:
- Environmental Acoustics
- Noise and Vibration
- Psycho and Physiological Acoustics
- Physical Acoustics
- Electroacoustics.

(iii) Special Sessions:
Besides ordinary sessions there will be special meetings and round-table discussions will be arranged on request.
In the afternoons there will be open sessions on co-ordinated research promoted by ICA on subjects of interest to the Scientific Committee on Problems of the Environment:
- Hearing Thresholds of Isolated Human Populations
- Sound Propagations Outdoors
- Noise Propagation in Buildings
- Effects of Noise on Wildlife Communication

(iv) Publications

(v) Advance Programme

(vi) Technical Visits

(vii) Definitive Registration (Registration must not be later than 1st February, 1977).

(viii) Fees
The Congress fee is US$70.00 which includes publications, attendance at Scientific Sessions, services such as banking, travel information and telex facilities, official reception and farewell party.
The fee for accompanying members is US$25.00.

(ix) Accommodation
Accommodation may be arranged at prices ranging between US$8.00 per person per night and US$53.00 per person per night.

(x) Satellite Symposia
Information on satellite symposia in Barcelona and Seville on "Sound Recording and Reproduction" and "Hearing and Industrial Noise Environments".

Copies of Circular 3 and further information is available from
Jack Rose
National Acoustical Laboratories
5 Hickson Street
Sydney, NSW, 2000
Phone: (02) 20537

INTERNATIONAL ACOUSTICS EVENTS

The following information on conferences and symposia have been supplied by:

International Commission on Acoustics (ICA)
Information Service
c/o Acoustical Commission of the Czechoslovak Academy of Sciences
Provaznicka 8, 110 00 Prague 1

1977

Argentine:
March 13-19, 1977, Buenos Aires
"XI World Congress of Otorhinolaryngology"
President: Prof. J. M. Tato
Secretary: Prof. Juan Carlos Aranz
Details not yet available.

Austria:
July 18-23, 1977, Ossiach
"Second Workshop on Physical and Neuropsychological Foundations of Music"
organized as part of the Carinthian Summer Festival 1977 in co-operation with Austrian Broadcasting Org. and Univeristy of Denver, Colorado, USA.
Subjects:
1. Acoustical Features of Musical Instruments relevant to Musical Tone Quality
2. Psychomotor control of Music Performance
3. Neuropsychological Aspects of Musicality

Write to:
Prof. Juan G. Roederer,
Dept. of Physics and Astronomy,
University of Denver,
Denver, Colorado, 80210

France:

a) **July 11-13, 1977, Paris, Centre Georges Pompidou**
"Symposium International sur la psychoacoustique musicale"
organise par l'Institut de Recherche et Coordination Acoustique-Musique (IRCAM) en association avec le Groupement des Acousticiens de Langue Francaise (GALF)
Details from:
IRCAM (Relations Exterieures)
31 rue Saint-Merri, 75004 Paris (France)

b) **September 5-10, 1977, Paris**
"International Conference on Lattice Dynamics" – various aspects of phonous and lattice dynamics.
Information from:
Prof. R. M. Pick,
Dept. de Recherches Physicues
Escalier 22, 4 Place Jussieu
75230 Paris, Cedex 05

Czechoslovakia:
October 1977, High Tatra Mountains
"16th Acoustical Conference on Noise and Environment" held by the Acoustical Commission of the Czechoslovak Academy of Sciences
Secretariat:
House of Technique,
Kocelova 17, 88130 Bratislava

Denmark:
August 15-18, 1977, Bella Center Copenhagen
"17th International Congress of Logopedics Phoniatrics"
Contact:
IALP Congress, Copenhagen Congress Center,
Belle Center A/S
Center Blvd. DK-2300 Copenhagen S

Great Britain

a) **June 29-July 1, 1977, Imperial College**
"Ultrasonics International 1977" – conference and exhibition –
Details from:
Dr. Z. Novak
Ultrasonics, IPC House
32 High Street
Buildford Surrey GU1 3EW

b) **September 12-23, 1977, Southampton**
"Diagnostics and Data Analysis Symposium"
Institute of Sound and Vibration Research University of Southampton, Southampton S09 5NH
Organiser: Dr. A. Hughes

c) **November 14-17, 1977, London**
"2nd Symposium of FASE on European Noise Legislation"
Main headings of the programme:
Criteria (derivation, surveys, L1, etc.)
Instrumentation (performance, accuracy, simplicity, costs, etc.)
Standards (review of national and intern. legislation, Social cost benefit, etc.)
Laws (types of laws, EEC, UK, inspectoriates, codes of practice, policing, enforcement, implementation, psychology.)
Organised by the Institute of Acoustics in collaboration with the British Soc. of Audiology and the Dept. of Environment.
Details from: Institute of Acoustics
Secretary: P.G.C. Mylne
47 Belgrave Square
London SW1X 8QX

Japan:

a) **April 19-22, 1977, Tokyo**
"Meeting of the Acoustical Society of Japan"
– all branches of acoustics –

b) **October (date fixed later) 1977, University of Shizuoka**
"Meeting of the Acoustical Society of Japan"
– all branches of acoustics –
On both, details from:
Acoustical Society of Japan
Ikeda Building,
7 Yoyogi 2-chome,
Shibuya-ku, Tokyo

Switzerland:

a) March 2-4, 1977, Zurich

"INTERNOISE 1977"

—main topic "Noise Control, the Engineer's Responsibility"—

1. Units, modern measurement and data acquisition methods.
2. Noise prediction for land use planning and idustrial hygiene
3. Optimum noise control in view of technical and legal constrains.

Secretariat:
Internoise 77
ETH
8006 Zurich

b) June 14-18, 1977, Basel

"7 Internationale Fachmesse fur Umweltschutz Pro Aqua – Pro Vita 77"
—Wesser, Abwasser, Abfall, Luft, Larm —
Sekretariat Pro Aqua – Pro Vita 77
c/o Schweizer Mustermesse
Postfach
Ch-4021 Basel

U.S.A.:

a) May 9-11, 1977, Sheraton Hotel Hartford, Conn.

"IEEE – International Conference on Acoustics, Speech and Signal Processing"
– also underwater acoustics, electro-acoustics and noise measurement–
General Chairman:
Harvey Silverman
IBM–T. J. Watson Research Center
POB 218
Yorktown Heights, N.Y. 10598

b) June 7-10, 1977, State College Pennsylv.

"Meeting of the Acoustical Society of America"
—all branches of acoustics—
Chairman: John C. Johnson
Pennsylvania State University
PA 16802

c) December 13-16, 1977, Miami Beach, Flor.

"Meeting of the Acoustical Society of America"
—all branches of acoustics—
Chairman: John G. Clark
Institute of Acoustical Res.
615 SW Second Avenue
Miami, FL 33130

Yugoslavia:

June 6-9, 1977, Banja Luka

"XXI ETAN Conference"
—all branches of Acoustics—
Information from:
Acoustical Society of Yugoslavia
Secretary Dr. P. Pravica
c/o Elektrotechnical Faculty
Bul. revolucije 73
11000 Beograd

1978

Czechoslovakia

Autumn 1978

"17th Acoustical Conference on Electroacoustics and Measuring Technique"
Organised by the Acoustical Commission of the Czechoslovak Academy of Sciences. Details to be announced.

Poland:

September 19-22, 1978, Warsaw

"2nd European Congress on Acoustics Of FASE"
—main topics: Acoustic waves and structure of matter, Ultrasonic methods of location and recognition, Objective and subjective evaluation of sound in limited space—
organised by the Acoustical Committee of the Polish Academy of Science and the Polish Society of Acoustics. Details to be announced.

U.S.A.

a) June 13-16 1978, University of Rhode Isl., Kingston

"Meeting of the Acoustical Society of America"
—all branches of acoustics—
Chairman: Stanley L. Ehrlich
Raytheon Co., Sub Signal Divis.
Box 360, Portsmouth, RI 02871

b) November 26-December 1 1978, Honolulu, Hawaii

"Meeting of the Acoustical Society of America"
—all branches of acoustics—
Chairman: John C. Burgess
University of Hawaii
2540 Dole Street, Honolulu
HI 96822

c) "INTERNOISE 78"
Details to be announced.

1979

Czechoslovakia:

Autumn 1979

"18th Acoustical Conference on Room and Building Acoustics"
organised by the Acoustical Commission of the Czechoslovak Academy of Sciences
Details to be announced.

Denmark:

August 1979, Copenhagen

"Ninth International Congress of Phonetic Sciences"
Information from:
Prof. E. Fischer-Jorgensen
Secretariat ISPhS
Kongestein 45, DK-2830 Virum, Denm.

Yugoslavia:

Mid September, 1979, Dubrovnik

"3rd Symposium of FASE on Building Acoustics::
Organised by the Acoustical Society of Yugoslavia in co-operation with Acoustical Commissions of Academies of Science of Czechoslovakia, Hungary and Roumania. Details to be announced.

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- Accurate field calibration
- Integral 4-digit read-out
- Optional remote microphone
- Concealed or visible display
- Extremely simple operation

do

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- Slip into worker's pocket for all-day measurement
- Mount stationary for area noise control
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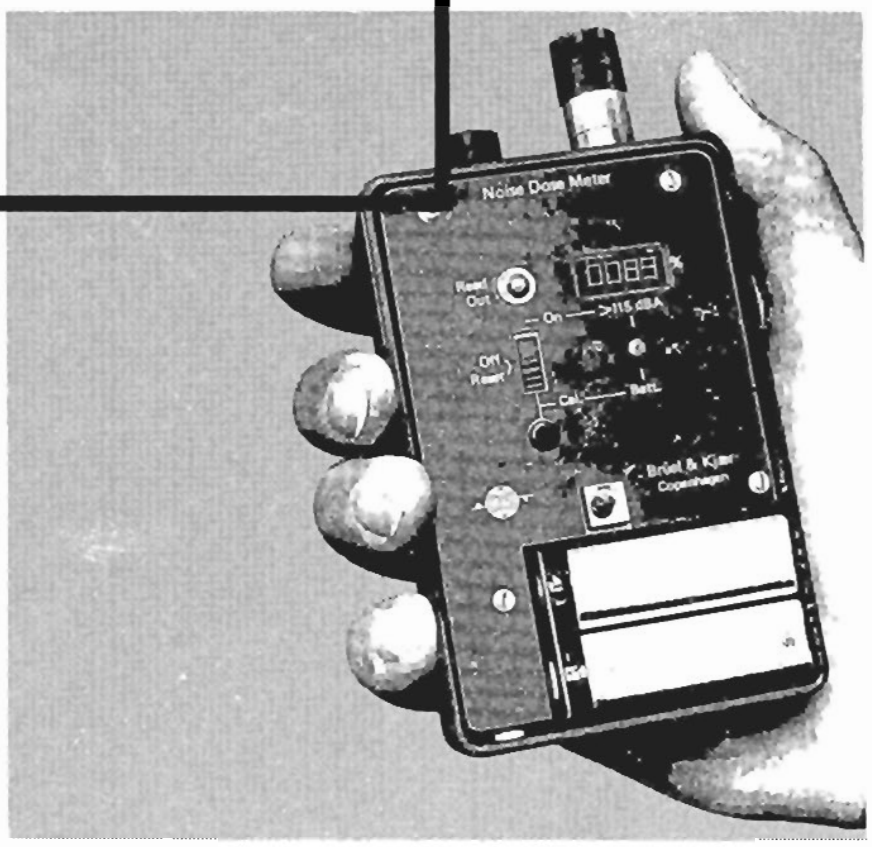

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P O Box 233, Moonee Ponds, Vic . 3039 Telephone 378169, 378160 Telex 33728

TENTH ICA IN AUSTRALIA

REPORT OF ICA SUB-COMMITTEE TO AAS ANNUAL GENERAL MEETING – MELBOURNE – SEPTEMBER 1976

J. A. Rose

The year since the ICA Sub-Committee last reported to the Society has seen a number of significant developments in relation to the holding of the 10th ICA in Australia in 1980.

Firstly, we forwarded a formal report on progress of the Society for consideration by the ICA at their meeting in March/April of this year.

The report outlined the formation of the West Australian Division, moves toward formation of the South Australian Division, the growth of all membership grades, Society activities since last reported and the special arrangements for setting up a fund in advance of the Congress.

After consultation with the State Divisions and representatives of the New Zealand Acoustical Society it also included a programme for the 10th Congress and satellite conferences on the following dates and themes.

Main Congress: Wednesday July 9, to Wednesday July 16, 1980, Sydney NSW, "Acoustics in the 80's".

Satellite Conferences: Monday July 7 – Tuesday July 8, **Victoria, "Shock and Vibration",** South Australia, "Recreational Noise and its Control".

Thursday July 17-Friday July 18, Western Australia **"Physiological Acoustics",** New Zealand, "Underwater Acoustics".

The main theme was meant to encompass the broadest spectrum of acoustics and thus draw support from as many overseas acousticians as possible while the satellite conference themes represent fields of specialised local expertise.

Though the Commission will not make any announcement of the allocation of the venue for the 10th ICA until it meets concurrently with the holding of the 9th ICA in Madrid next year, it has informed its parent body, the International Union for Pure and Applied Physics, that a firm decision has been made for Australia and Professor Clarkson, in discussions with our President, Carolyn Mather, suggested that we drop all references to the possibility that the meeting may not be held here as planned.

In consequence of this we have set in motion a series of actions planned for such an eventuality. These have involved enlargement of the Sub-committee, allocation of specific areas of planning to particular members, establishment of mechanisms for liaison with Divisions and moves to keep the general membership fully informed of how things are progressing.

In this regard members will have seen already a news item in the June issue of the AAS Bulletin. Look for more of these in each issue in the section dealing with conferences.

We have notified various organisations who may assist us with the planning of the congress of our success and will be negotiating further to obtain the best deal for the Society if and when we need them.

The Sub-committee is particularly thankful to the N.S.W. Division for its contribution of the $1000 profit from the Medlow Bath Conference and, also for the levies forwarded by Divisions. This has enabled us to place $1500 in a high-interest account which falls due in 1979 while retaining sufficient for a small working capital. We intend to keep preliminary expenses to the minimum and place all further funds into high-yield areas as soon as we receive them.

Following a suggestion from Professor Clarkson we have begun informal negotiations with the Audiological Society of Australia and the Australian Branch of the World Federation for Ultrasound in Medicine and Biology for the possible holding of conferences in Australia on dates which could attract acoustical specialists in these fields to attend ICA, satellite conferences and their own specialised meetings. It is too soon to assess how successful this will be but we intend to liaise with any group who will encourage a larger number of overseas acousticians to visit Australia and attend ICA as, the greater the number, the more benefit will be derived by Australian acousticians generally which, in turn, must be of ultimate benefit to the Society.

The importance of ICA with regard to the growth in Australia of acoustics generally, and the Society in particular cannot be stressed too highly.

Members should use ICA as a strong argument when recruiting new members and especially for Sustaining Members as allocation of such an event is a measure of our standing in the acoustical world and also because they will be asked to accept a larger proportion of the load associated with financing the Congress in the years following the official announcement.

Also, even before that announcement, members when travelling overseas or contacting colleagues by letter would help the Society's goal if they publicised the meeting and stressed the advantage this event has as the only possibility many European or American acousticians will ever have to visit Australia.

We remind members, and especially those who may be associated with the planning of the 1980 ICA or its satellite conferences, that attendance at the 9th ICA in Madrid next year would be not only rewarding as a chance to hear and discuss their ideas with overseas specialists but also of inestimable value for observing the problems and

techniques for running successful conferences.

The ICA Congress will be held from Monday July 4 to Saturday July 9. The theme is "Acoustics and Habitat" which must be of interest to a wide spectrum of Australian acousticians and the Satellite conference dates and themes are:—

Barcelona, Friday July 1 to Saturday July 2. "Sound Recording and Reproduction".

Seville, Monday July 11 to Tuesday July 12. "Hearing and Industrial Noise Environments".

While both will be of great interest to most Australian delegates the second conference has a special meeting on "impulsive noise hazards" which is of major significance for hearing conservation.

The sub-committee is prepared to organise travel arrangements on behalf of those who wish to attend the 9th ICA. The greater the number the better the deal will be in relation to both price and flexibility of schedules and visits to other centres of acoustical interest, so please notify us soon of your intention to attend so that we can negotiate these matters from a strong position.

The sub-committee reports a successful year and looks forward to the coming year as one of great importance for setting up the organisation which will ensure a success in 1980 and thereby enhance the status of the Society and acoustics generally in Australia.

BOOK REVIEW

NOISE AND NOISE CONTROL, Vol. I

M. J. Crocker and A. J. Price. CRC Press, 1975. 309 pp., illus., Price: US$32.95.

I have heard that many publishers are severely restricting the number of text-books they send out for review because the number of free copies issued in this way exceeds the number of sales in many cases. I will be the first to applaud if such measures are taken by all publishers, because I consider such "gifts" are often wasted, especially when the book is a fundamental text.

The review often appears to be written from the dust jacket and the table of contents. I suspect the book is never used and the genuine student of the subject pays more for his books as a consequence. And if the genuine student has the misfortune to live in Australia, the distributors will make sure he is further discouraged from educating himself by charging at least twice as much for the book as it would cost in the UK or USA.

Having said all that, I hope CRC Press send me Volume II of Noise and Noise Control before they too restrict their free issues, because if it is anything like Volume I it will be expensive but worth buying. Volume I is a refreshing departure from most of the books on noise control that have been published in recent years. The theory and references are given for anyone wishing to go into the subject in detail but the book can be read on a more superficial or descriptive level. The authors have obviously used some very recent primary source material (the most recent reference is dated 1975) which, for a book which is primarily one on fundamentals, is commendable.

The book is in five chapters:

- Some Fundamentals of Sound and Vibration
- Human Hearing and Subjective Response to Sound
- Instrumentation for Sound and Fibration Measurement
- Acoustics of Enclosures and
- Architectural Acoustics.

My main criticism of this book involves the chapter on Architectural Acoustics. Obviously an important part of noise control work involves buildings, but most of the chapter on Architectural Acoustics is concerned with criteria for the design of auditoria, which has very little relevance to a book on Noise Control.

Photographs of instruments are included in the book which is a useful departure from normal procedure. The photographs however give no indication of the size of the instruments and could be misleading about the number of manufacturers in the field.

Reviewed by Fergus Fricke.

STANDARDS REPORT

STANDARDS ASSOCIATION OF AUSTRALIA
AK/– ACOUSTICS STANDARDS COMMITTEE
COMMITTEE ACTIVITIES JULY 1975 – JUNE 1976

R. Nagarajan,
Engineer-Secretary,
Standards Association of Australia.

General

During the period July 1975 – June 1976, all the Acoustics Standards Committees and Acoustics Executive maintained a high level of activity. The statistics of the above committee activities during this period are given below:

New and revised standards published	5
Drafts issued for public review	2
Meetings held	24
Projects in hand	30
Standards in course of publication	7

An effective co-ordination was maintained with the activities of ISO/TC 43, Acoustics and IEC/TC 29, Electro acoustics by way of submission of Australian comments on international draft standards at various committee stages.

AK/– Committee was represented during the meetings of ISO/TC 43/SC 1 Noise by Dr Carolyn Mather and IEC/TC 29 – Electro acoustics by Mr Louis A. Challis, held in U.S.A. Mr John Irvine also attended the meetings of ISO/TC 43/SC 2 – Building Acoustics held recently in Paris.

The details of activities of the various AK/– Committees are given below. A number designation has been used to indicate the stage which each current project has reached, as follows:

1. Investigation and preliminary work
2. Committee drafting
3. Draft issued for public review
4. Review of comment
5. Postal ballot and final stages
6. In course of publication

An asterisk (*) denotes a new project started during the year.

Committee: **AK/1 – Terms Units and Symbols**
Chairman: A. K. Connor
Secretary: R. Nagarajan (SAA Staff)
Activities: The committee continues to survey standards produced by other committees to ensure that any new or amended definition can be included in AS 1633 when a reprint is required. Other committees are invited to submit proposals for items to be included or amended at that time. A detailed comparison of AS 1633 with ISO/DIS 31/VII has been made. In general there is close agreement between composable items in the two publications. A short list of minor amendments and additions has been prepared for use when AS 1633 is reprinted.

Committee: **AK/2 – Instrumentation and Techniques of Measurement**
Chairman: R. A. Piesse (National Acoustic Laboratories)
Deputy Chairman: P. Dubout (CSIRO Division of Building Research)
Secretary: R. K. Profitt (SAA Staff)

Standards Published:
1081 Measurement of Airborne Noise Emitted by Rotating Electrical Machinery
1259 Sound Level Meters
Part 1 General Purpose (Revision of AS Z37-1967)
Part 2 Precision (Revision of AS Z38-1967)
Part 3 Precision Sound Level Meter for the Measurement of Impulsive Sounds.

Current Projects:

Pressure calibration of microphones by the reciprocity technique (to be 1232)	6
Guidance for the use of sound level meters	2
Revision of AS 1217-1972, Methods of measurement of airborne sound emitted by machines	2
Revision and consolidation of AS 1259, Parts 1, 2 and 3	1

Activities: Three meetings were held during the year and four standards published. Three projects were dropped from the programme of work and work on a revision of AS 1217, in terms of ISO standards will be progressed with.

Sub-committee: **AK/2/1 – Instrumentation for Otological and Audiological Measurement**
Chairman: R. A. Piesse (National Acoustic Laboratories)
Secretary: R. K. Profitt (SAA Staff)

Current Projects:

Speech audiometers	5
Background noise level for audiometer rooms	2
Pure tone audiometer for advanced audiological use	2

Activities: The subcommittee maintained a watching brief of IEC and ISO drafts of interest with a view to maintaining the Australian standards already published.

Committee: **AK/3 – Hearing Conservation**
Chairman: Dr. R. Neil Reilly (Consulting Otologist)
Deputy Chairman: Dr A. G. Cumpston (Department of Public Health, W.A.)
Secretary: R. Nagarajan (SAA Staff)

Standards Published:
1270, Hearing protection devices

Current Projects:
Code of practice for hearing conservation (to be 1269) . . . 6

Activities: Considerable work has been carried out in reconciling the comments on the Draft Code of Hearing Conservation to the postal ballot stage and processing the same towards publication.

Committee: **AK/4 – Architectural Acoustics**
Chairman: Dr C. Mather (Public Works Department, W.A.)
Deputy Chairman: J. D. Buntine (R.M.I.T.)
Secretary: R. Nagarajan (SAA Staff)

Draft Standards Issued:
DR 75136, Ambient sound levels for areas of occupancy within buildings

Current Projects:
Test methods for air duct attenuators (to be AS 1277) . . . 6
Field measurement for the reduction of airborne sound transmission in buildings 4
Laboratory measurement of airborne sound transmission loss of building partitions (to be AS 1191) 6
Ambient sound levels for areas of occupancy in buildings 3
Measurement and rating for sound insulation for building envelopes 2
Measurement of normal incidence sound absorption coefficient and specific normal acoustic impedance of acoustic materials by the tube method (to be AS 1935) 6
Plumbing and drainage noise 1
Measurement of reverberation and absorption in rooms 1
Measurement of airborne sound attenuation of ceilings between two rooms 2

Activities: The committee met 3 times during the year and finalized for printing three standards test methods for air duct attenuators (to be AS 1277); laboratory measurement of airborne sound transmission loss of building partitions (to be AS 1191); and measurement of normal incidence sound absorption coefficient and specific normal acoustic impedance of acoustic materials by the tube method (to be AS 1935). A draft code for ambient sound levels for areas of occupancy within buildings (DR 75136) was issued for public comment and draft on field measurement for the reduction of airborne sound transmission in buildings was progressed to the postal ballot stage.

Sub-Committee: **AK/4/1 – Building Siting and Construction Against Aircraft Noise Intrusion**
Chairman: Dr C Mather (Public Works Department, W.A.)
Secretary: R. Nagarajan (SAA Staff)

Current Projects:
Building siting and construction against aircraft noise intrusion 6

Activities: This subcommittee met twice during the year and after consideration of public review comments and subsequent postal ballot stage has finalized the code of practice for building siting and construction against aircraft noise intrusion.

Committee: **AK/5 – Community Noise**
Chairman: Professor Anita Lawrence (University of N.S.W.)
Deputy Chairman: W.A. Davern (CSIRO Division of Building Research)
Secretary: R. Nagarajan (SAA Staff)

Current Projects:
Determination of motor vehicle noise emission 4
Noise assessment in residential areas (Revision of AS 1055) 5
Noise assessment in commercial areas 2
Noise assessment in industrial areas 2

Activities: The two working groups of this committee met four times and the full committee met once. The draft revision of AS 1055, Noise assessment in residential areas has reached the postal ballot stage. Consideration of public review comments on DR 75075, Draft method for determination of motor vehicle noise emission has been completed by the working group and a revised draft is under consideration by the working group. Work on noise assessment in industrial and commercial areas will be taken up after work on revision of AS 1055 is completed.

Committee: **AK/6 – Aircraft Noise**
Chairman: Dr R. C. Willis (Otolaryngological Society of Australia)
Deputy Chairman: J. A. Rose (National Acoustic Laboratories)
Secretary: R. Nagarajan (SAA Staff)
Activities: The committee maintained a watching brief on the ISO work in this field and maintained co-ordination with the work of Subcommittee AK/4/1, Building Siting and Construction Against Aircraft Noise Intrusion.

Committee: **AK/7 – Engineering Acoustics**
Chairman: R. B. King (Consulting Engineer)
Secretary: R. Nagarajan (SAA Staff)
Activities: The committee maintained a watching brief on ISO Drafts and the work of Subcommittees AK/7/1 – Noise in Ships and AK/7/2 – Noise from Agricultural Tractors and Earthmoving Machinery.

Sub-Committee: **AK/7/1 – Noise in Ships**
Chairman: Capt. D. Wharington (Dept of Transport)
Secretary: R. Nagarajan (SAA Staff)

Current Projects:
Measurement of airborne noise on board vessels 6
Measurement of airborne noise emitted by vessels on waterways in ports and harbours 6
*Recommended noise levels on board vessels 2
*Recommended noise levels emitted by vessels on waterways in ports and harbours 1

Activities: The subcommittee met twice during the year and finalized for printing the Method for measurement of airborne noise on board vessels (to be AS 1948) and the method for measurement of airborne noise emitted by vessels on waterways in ports and harbours (to be AS 1949). The draft on recommended noise levels on board vessels has been progressed to the public review stage.

Sub-committee: **AK/7/2 – Noise from Agricultural Tractors and Earthmoving Machinery**
Chairman: W. Brown (University of Melbourne)
Secretary: R. Nagarajan (SAA Staff)

Draft Standards Issued:
DR 75137, Method for measurement of airborne noise

from agricultural tractors and earthmoving machinery.

Current Projects:

Method for measurement of airborne noise from agricultural tractors and earthmoving machinery 4

Activities: This subcommittee met two times this year and has, in a recent meeting held on 20 August 1976, finalized the method for measurement of airborne noise from agricultural tractors and earthmoving machinery. This finalized standard is in course of approval and submission for printing.

Sub-committee: **AK/7/3 — Noise from Pneumatic Compressors, Tools and Machinest**

Chairman: R. B. King (Consulting Engineer)

Secretary: R. Nagarajan (SAA Staff)

Current Projects:

Measurement of sound power level of compressors 2

Measurement of sound power level in pneumatic tools and machinery 1

Maximum permissible sound power levels of pneumatic tools and air compressors 1

Activities: This subcommittee is likely to meet later this year to consider ISO draft documents on measurements of sound power levels of compressors and pneumatic tools and machinery with a view to preparation of draft documents meeting our needs and requirements.

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†is being constituted as requested by AK Executive at the last meeting held on May 1976 (see Doc AK/—/1/76-4).

AUSTRALIAN ACOUSTICAL SOCIETY

INCOME AND EXPENDITURE ACCOUNT FOR YEAR ENDED 30TH JUNE, 1976

	EXPENDITURE			INCOME	
To	NSW Division (Reimbursement for establishing ICA Account)		200.00	By Sustaining Members (9)	1530.00
	NSW Division (Part reimbursement for legal and Bulletin costs)		976.12	1975 ICA Levy on Vic (104 members)	520.00
	NSW Division (Legal Fees for ACT Office)		40.00	1975 ICA Levy on NSW (118 members)	590.00
	ICA Fund (Proceeds of 1975 levies on Vic. and NSW)		1110.00		
	Postage, Stationery, Photocopies, Typing		81.76		
	Travelling and Accommodation		33.60		
	Bank Fees		10.00		
			2451.48		
	Surplus for Year		188.52		
			$2640.00		$2640.00

BALANCE SHEET AS AT 30TH JUNE, 1976

LIABILITIES			ASSETS	
Accumulated Funds			Commercial Banking Co. of Sydney, Crows Nest	846.36
Balance as at 30th June, 1976	657.84			
Add Surplus for Year	188.52	846.36		
		$ 846.36		$ 846.36

AUDITOR'S REPORT

I report that I have examined the records of the Australian Acoustical Society for the year ended 30th June, 1976, and in my opinion the above Balance Sheet and Income and Expenditure Account are properly drawn up so as to give a true and fair view of the state of affairs of the Society.

F. J. MORTON
Registered under the Public Accountants Registration Act, 1945, as amended

Dated: 10th August 1976 **Place:** Crows Nest

TESTING OF WOOD AND WOOD PRODUCTS BY ACOUSTIC TECHNIQUES

J. I. DUNLOP

SUMMARY

The testing of wood using acoustic techniques has been proposed many times in the past. Acoustic testing possesses many advantageous features over conventional test methods, but there are inherent difficulties that limit its application to the testing of wood. An appraisal is made of the several acoustic techniques that might be applied to the testing of wood.

Introduction

Wood and wood products are widely used in many industries and have many applications. On a world wide basis annual consumption has reached some 10^9 tonnes, an amount almost equivalent to the annual consumption of iron and steel[1]. This use of wood has been largely traditional. The engineering applications have been simple and the methods of testing the raw material relatively crude.

Some of the excellent mechanical properties of wood, its anisotropy and high strength to weight ratio, are now being reappraised not only for traditional applications but also for use in some highly specialised fields; two recent examples being rocket nose cones and the framework for lighter-than-air ships. These applications, together with the intrinsically variable nature of wood have resulted in some urgency to develop more effective methods for testing and assessing the properties of wood.

The properties of wood and wood products most often requiring examination are the strength properties (modulus of elasticity and rupture strength) although density and moisture content are also important. The traditional methods of testing, elastic bending or bending to destruction, have limitations because of the expense in materials, handling, capital equipment and, in the case of destructive testing, the low level of confidence when the results are extrapolated to untested samples. Tests employing acoustic techniques appear promising as the basic acoustic parameters are closely related to moduli and the tests offer the possibility of a cheap, non-destructive method with field capabilities.

Acoustic Velocity

There are several acoustic tests that can be applied to the testing of wood, the most useful being the determination of the velocity of compressional or other acoustic waves. The velocity may then be related to the modulus (E) and density (ρ) of the material by such formulae as,

$$v = \frac{E}{\nu} \text{ or } v = \sqrt{\frac{E\,(1+\nu)}{\rho(1-\nu)\,(1+2\nu)}}$$

where ν is Poisson's ratio.

The velocity of acoustic waves can be determined in a variety of ways, one of them being to measure the frequency with which a sample will resonate with respect to certain types of stress wave. The frequency may then be related to the dimensions of the specimen and the velocity of the acoustic waves calculated. Various forms of apparatus have been employed here, utilising frequencies that range from infrasonic vibrations to upper sonic frequencies. At infrasonic test frequencies, the wood specimen is clamped at one end and a mass attached to the other and the specimen set in vibration (either torsional or flexural). At higher frequenies, measurements usually require electronic apparatus for exciting and detecting the vibration. These methods are generally quite restrictive in the method and type of clamping and the maximum size sample that may be tested. They have usually been applied to flexural waves in beams and sheets

Another method of determining the velocity is to measure the transit times of acoustic pulses or wavepackets as they travel through a given length of material. This is probably the simplest method and is the basis of several instruments currently used in non destructive testing of many other materials (steel, concrete). When anomalous results are obtained they can often be used to make inferences about the presence of cracks or voids within the material.

There are two principal methods currently in use for determining the velocities or transit times of these acoustic signals. One system relies on the use of mechanical impacts, from a pendulum, ball or spring loaded hammer, to produce a stress pulse. The other generates a wave packet using piezo electric transducers. The mechanical impact system offers some advantages over the other systems, eg simpler equipment and the facility to operate at higher signal levels, but it suffers limitations from the long risetime of the pulse ($\doteq$ 250 μS). This problem, coupled with the variability of the impact intensity leads to appreciable scatter in the transit times recorded; about 20-50 μS being often observed.

The electronic excitation technique applies a short duration electric pulse (typically 800 V for 6 μS) to a transducer which then rings at its resonant frequency, usually 20-100 kHz, and when coupled to the material transmits a

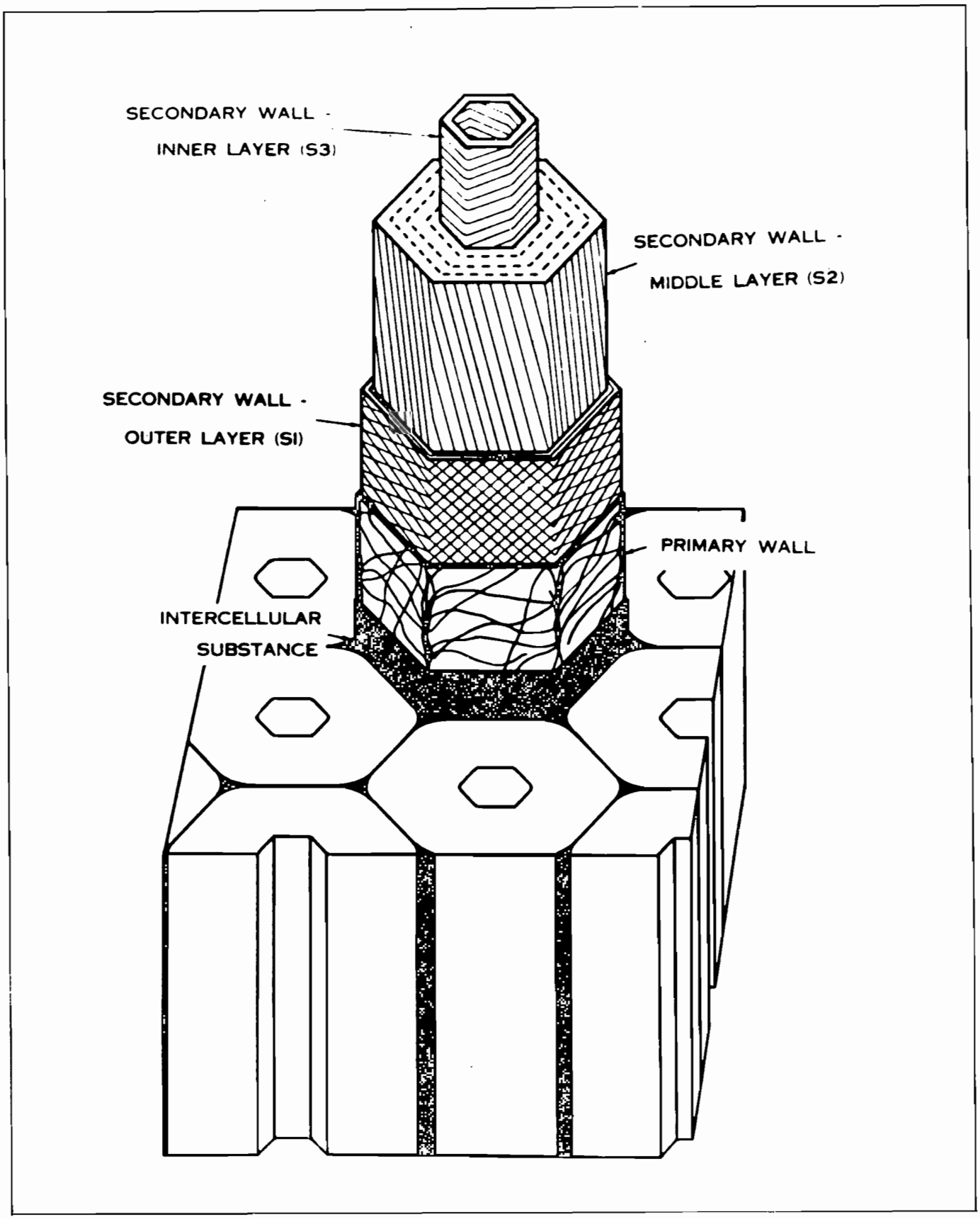

Fig. 1. Simplified structure of the cell wall of a softwood tracheid or a hardwood fibre (Wardrop and Bland, 1959).

wave packet through it. The risetime of the received signal is thus very short leading to results of high precision, with typically 1 or 2 μS variation. Difficulties arise because of poor coupling between the metal housings of the transducers and the porous wood surface unless a coupling fluid is used, which may then stain the wood. This poor coupling leads to low signal intensity which may result in the initial part of the received signal being too weak to trigger the duration counter and hence yield longer transit time readings.

An alternative technique for determining the velocity of acoustic waves in porous materials is to make comparative measurements of the relative phase of the emerging acoustic wave, which may then be related to the wavelength. This method allows the use of low frequencies and has proven useful in detecting the presence of flaws such as delaminations, air gaps etc in honeycomb structured timbers, plywoods and particle boards.

The velocities of acoustic pulses in wood have been observed [2] to vary between fairly wide limits; 3-6 km/S along the grain and 0.8–1.5 km/sec across the grain. These differences are largely independent of the wood's bulk density (as distinct from the specific gravity of the wood substance which is fairly constant for all woods at 1.46), and is most likely due to variations in the angle of the fibrils in the cell walls of the tracheids which make up the structure of wood (see Figure 1). The latter has been noted to be responsible for large variations in the modulus of similar woods. The velocities determined by this technqie refer to the fastest pathway through the wood between the transmitter and receiver, and take no account of the many non-uniformities that may exist in the timber specimen. These non-uniformities such as knots, cracks, splits and local decay, and the bulk density of the wood may ultimately determine the strength or load bearing properties of the specimen so that moduli derived from velocity measurements have obvious limitations.

In the case of wood composites such as particle board, flake board and hardboard these limitations are not so severe, as the material is generally more uniform in its physical properties. Acoustic velocities along the plane of particle board may vary in the range 2-2.8 km/S and through the board in the range 0.7-1.9 km/S.[3] These values are consistent with the timber velocities: wood chips, cut with their long dimensions along the grain, are aligned randomly along the plane of the board so that the acoustic velocity along the board should be an average of the two timber velocities, and is lowered by the fact that the pulse probably travels in a somewhat zig zag path to avoid gaps and other discontinuities; through the board, which is perpendicular to the wood chip alignment, the velocity should be dependent on the transverse velocity in timber lowered again by the zig zag effect.

Strong correlations[3] have been obtained between the squares of velocity and different strength properties of the board, especially the modulus of elasticity and modulus of rupture. These correlations offer the possibility of using acoustic velocity measurement to monitor quality control during manufacture or to specify the quality gradings of finished boards.

Acoustic Impedance

Measurement of acoustic impedance is another technique that has enjoyed some success in non destructive testing, for example measurement of the acoustic impedance of the human ear is employed as a diagnostic technique. Its application to the measurement of the properties of solids has however been more limited. There are two impedance values that could be of interest – the specific impedance of the material ($Z_o = \rho C$) or the effective impedance of the specimen which is a function of the dimensions as well as its modulus and density. In the case of wood and wood products the specific impedance is so great that any attempt to measure it usually results in measurement of the effective impedance of the specimen, which is of much smaller magnitude. The technique offers a more sophisticated and informative test than that of simple vibration resonance but suffers from the same difficulties of defining modes, boundaries and clamping conditions and has therefore had limited use.

One instance of its successful application is the work of Suddarth[4] who made measurements of acoustic impedance normal to the surface of plywood sheeting in an attempt to locate and define delaminations or voids between the plies. Impedance values were determined and contours of equal impedance value drawn on the surface of the sheet so that the positions and shapes of delaminations could be predicted. The apparatus, however, was not developed beyond the prototype laboratory instrument.

There are also techniques such as pulse echo or echo sounding that rely on the change of impedance, which might occur at the solid/air interface of a void, to produce a strong reflection of acoustic waves. Such techniques have been used for many years in the metal industries and in marine applications but their application to timber testing appears quite unprofitable for several reasons, the principal one being that wood is an air solid granular mixture which would produce great scattering of the high frequency waves used in pulse echo techniques.

Reverberation

The existence of delaminations in plywood or other laminated wood product can often be detected by a reverberation technique – the sheet is tapped or brushed and a subjective assessment is then made by an experienced tester. Reverberation techniques are also used to determine the strength or soundness of such timber components as poles and beams, but as in the case of plywood the method remains largely subjective due to the wide range of shapes and sizes of most components and the difficulties of controlling and detecting the dominant modes excited.

Damping Loss

Measurement of the acoustic damping of a material yields information about its visco-elasticity. The sources of this viscoelasticity are several and relate to particular molecular rearrangements that take place when wood is subjected to stress, leading invariably to stress relaxation or creep. Two notable sources of viscoelasticity are known to occur in wood. Firstly, there is the segmental movement of cellulose chains in the amorphous regions of the wood

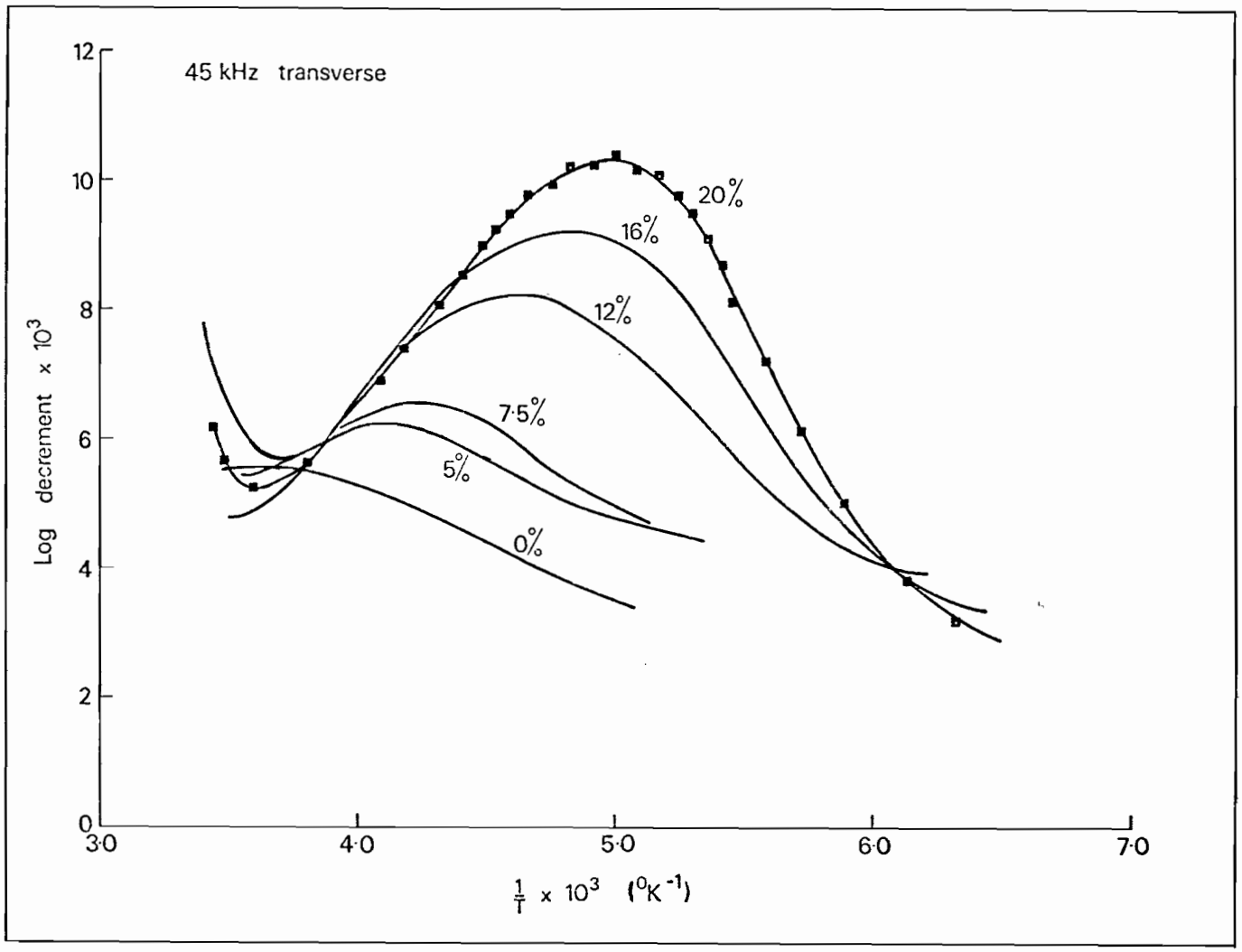

Fig. 2. Damping loss versus temperature for various values of moisture content.

structure, the effect of which is observed as a maximum in the damping loss at low frequencies (1 Hz) and moderately high temperatures (30 to 80°C).[5] At higher frequencies (10 to 100 kHz) and lower temperatures (0 to −80°C) the effects of another loss mechanism, due to the water of hydration in cellulose[6], are seen as a maximum in the damping loss in this region. Typical damping loss versus temperature curves at different moisture contents are shown in Figure 2.

This maxima in the damping loss would occur at room temperature in the frequency range 0.5 to 1 Mhz, so that measurement of the damping loss in this frequency range would be sensitive to the moisture content of the wood. Determination of moisture content by measurement of dielectric loss, which in the case of this loss mechanism is analogous to mechanical loss, is an accepted test method but damping loss techniques are still very much in a state of development.

Conclusions

The range of acoustical tests that may be usefully applied to the testing of wood and wood products is limited. The most promising at this stage appears to be the measurement of compressional wave velocity in reconstituted boards or sheets by the pulse transit time method, although the subjective assessment of reverberation will continue to be a useful technique.

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EXPERIMENTAL INVESTIGATION OF THE ACOUSTIC PROPERTIES OF GRANULAR MATERIALS

RAJENDRA SINGH and FERGUS FRICKE

SUMMARY

The acoustic properties of granular materials would appear to make them very useful in both architectural applications and in fundamental studies of the absorption and transmission of sound. In this paper, the results of an experimental investigation of the normal acoustic impedance and absorption coefficients of several granular materials are presented.

INTRODUCTION

Granular materials (such as sand) are widely recognized as efficient acoustic insulators and have been used in the construction of buildings[1] to improve the sound transmission loss of partitions for some time.

The main objective of the present study is to investigate the acoustic behaviour of granular materials so that these materials can be used effectively. From the economic and availability point of view, they are attractive sound absorbing materials. The acoustic property dats of such materials would enable the designer and architect to suggest suitable applications.

An analytical study of the granular materials involves determination of the following macroscopic constants; the flow resistance, porosity, and structure factor. These physical properties control the sound propagation of air in the voids. If the material frame is vibrating, then the stiffness of the material should also be added to the list of parameters. The acoustic wave impedance and propagation constant are complex quantities and depend upon the physical properties of the material.

The acoustic impedance of a certain thickess of a material can be derived in the form of acoustic transmission line expressions. By applying the basic equations of physical acoustics, the absorption coefficient and the transmission and attenuation characteristics can be obtained.

In this paper, the results of an experimental determination of the acoustical properties of several granular materials are presented. The evaluation of normal acoustic impedance and sound power absorption coefficient was carried out using the standing wave tube method.

MEASUREMENTS

The samples of granular materials were identified by their grain size as it is common practice for construction engineers and architects to choose granular materials by their screen mesh size. The bulk sample was taken from the Wabash river, Lafayette, Indiana, and was filtered out through screens to obtain samples of particular grain or wire mesh size. Table 1 shows the identification numbers of the samples and their sizes. The size of each sample was in accordance with the recommendations of the American Society for Testing and Materials as follows: Sample 1 passed though a wire mesh screen of 4 mm opening but stayed in a 2 mm mesh screen; thus the size of this sample is 4 mm. The last sample, no. 6, passed through a 125 micron screen but stayed in 74 micron screen. The sample size range was from 4 mm to 125 micron and there were in all six samples. The samples 1, 2 and 3 were small stones in physical structure whereas 4, 5 and 6 were more or less in powder form or fine sand. The experimental tests were conducted on B & K Standing Wave Apparatus 4002.

The schematic of the experimental setup is shown in Figure 1. The loudspeaker at one end of the tube was driven at the desired test frequency from an audio-frequency sine-oscillator with power amplifier. The signal from the microphone was fed into a frequency analyzer through an amplifier. The standing wave tube was tilted to hold the samples in the tube as no bonding or adhesive was used – in the normal horizontal position of the tube, the sample would tend to slump. The samples were placed in a holder in such a way that the sample thickness could be varied from 1.0 inch (2.54 cm) to 2.5 inches (6.35 cm) in intervals of 0.5 inches (1.27 cm). Thus, in all, observations for four thicknesses of each material were taken.

The tests were performed according to the American Society for Testing and Materials Standard C384-58(72)[2]. The test frequencies were the centre frequencies of the one-third octave bands in the range 125 to 6000 Hz.

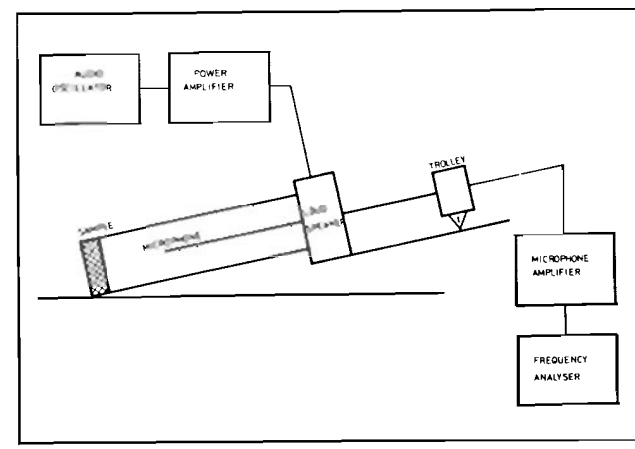

Fig. 1. Schematic of Experimental Set-Up.

Table 1. Sample Sizes

Sample Identification Number	Size	Opening of Wire Mesh in inches	Taylor Equivalent Mesh	Bulk Density	
				kg/m^3	Lbm/ft^3
1	4.0 mm	0.157	5	1.55×10^3	96.76
2	2.0 mm	0.0787	9	1.55×10^3	96.76
3	1.0 mm	0.0394	16	1.55×10^3	96.76
4	500 micron	0.0197	32	1.50×10^3	93.645
5	250 micron	0.0098	60	1.45×10^3	93.645
6	125 micron	0.0049	115	1.45×10^3	90.52

RESULTS AND DECISIONS

The standing wave ratio, location of first minimum and the distance between two minima were measured. Using Smith's chart[2], normal acoustic impedances and sound power absorption coefficients were obtained. Some representative results have been shown, from Figures 2 to 5, to illustrate the nature of the acoustic behaviour of the granular materials. In Figures 2 and 3, the magnitude of the dimensionless normal acoustic impedance (Z) has been plotted in one third octave frequency intervals. The dimensionless acoustic impedance Z is defined as:

$$\bar{Z} = \frac{Z}{\rho_o c_o}$$

where Z is the acoustic impedance and is the complex quotient of pressure and particle velocity, ρ_o is the mean density of air and c_o is mean speed of sound in air.

Figure 2 shows that impedance drops off rapidly as the frequency is increased. After 1 kHz the impedance is more or less constant but above 4 kHz it shows a tendency to rise. At low frequencies each sample behaves virtually as a rigid wall but as the frequency is increased the impedance decreases rapidly, especially at the low frequency end. As shown in Figure 3, however, at high frequencies the thickness variation has negligible effect on the impedance.

From this impedance information it is obvious that the compliance of air in voids is playing an important part in the behaviour of the materials at low frequencies. At intermediate frequencies, compliance and interia effects seem to be nullifying each other, thus keeping impedance at a minimum. The rise in impedance shows that impedance is a periodic type of function.

Another interesting conclusion from Figure 3 is that with smaller mesh sizes, the impedance is low, i.e. with increase in the size of the grain, impedance also increases. Possibly this is because the smaller grain size has more paths available and hence the flow resistance is lower.

Some of the above mentioned results can be verified from the fact that for any material of thickness L, backed by a hard wall, the impedance at the face of the material is proportional to $\coth \gamma L$ where γ is the propagation constant.

Figures 4 and 5 show the absorption coefficient (α) of granular materials in one third octave frequency intervals. The absorption coefficients have maxima in the frequency range of 1 kHz to 2 kHz. At low frequencies, α is very small but increases with frequency and also with an increase in material thickness. After reaching a maximum, α drops off. This indicates a periodic type behaviour in the frequency domain (like impedance). With increased thicknesses, the maxima shift to the left, thus resembling the behaviour of of fibrous materials. From Figure 4, it can be seen that samples 1, 2, and 3 are similar in behaviour with 3 showing a drift at high frequencies. Similarly at low frequencies 4, 5, and 6 have more or less the same α, but tend to differ in the high frequency range.

With smaller mesh (or grain) size, the absorption coefficients are high, and increase at high frequencies. It is obvious that the samples with larger grain sizes behave in the fashion of a rigid surface with small absorption. Samples with smaller grain sizes behave like more common porous or fibrous materials, and hence show high absorption coefficients.

Since the significance of material structure on acoustic wave propagation is not known for granular materials, nothing can be predicted regarding the relationships between physical and acoustical properties. The bulk density however, does not appear to be significant, as it was virtually the same for all the samples listed in Table 1, and yet their acoustic behaviour was widely different.

CONCLUSION

The present study, demonstrates that granular materials have useful sound absorbing capacities and thus can be recommended as absorbers. Unlike other porous materials, however they are also effective sound insulators.

Granular materials are also attractive for fundamental studies of sound absorption as their structure and physical properties can be more easily defined than either fibrous or porous materials. This may therefore lead to mathematical treatment of inhomogenous and isotropic materials with controlled experimental verification.

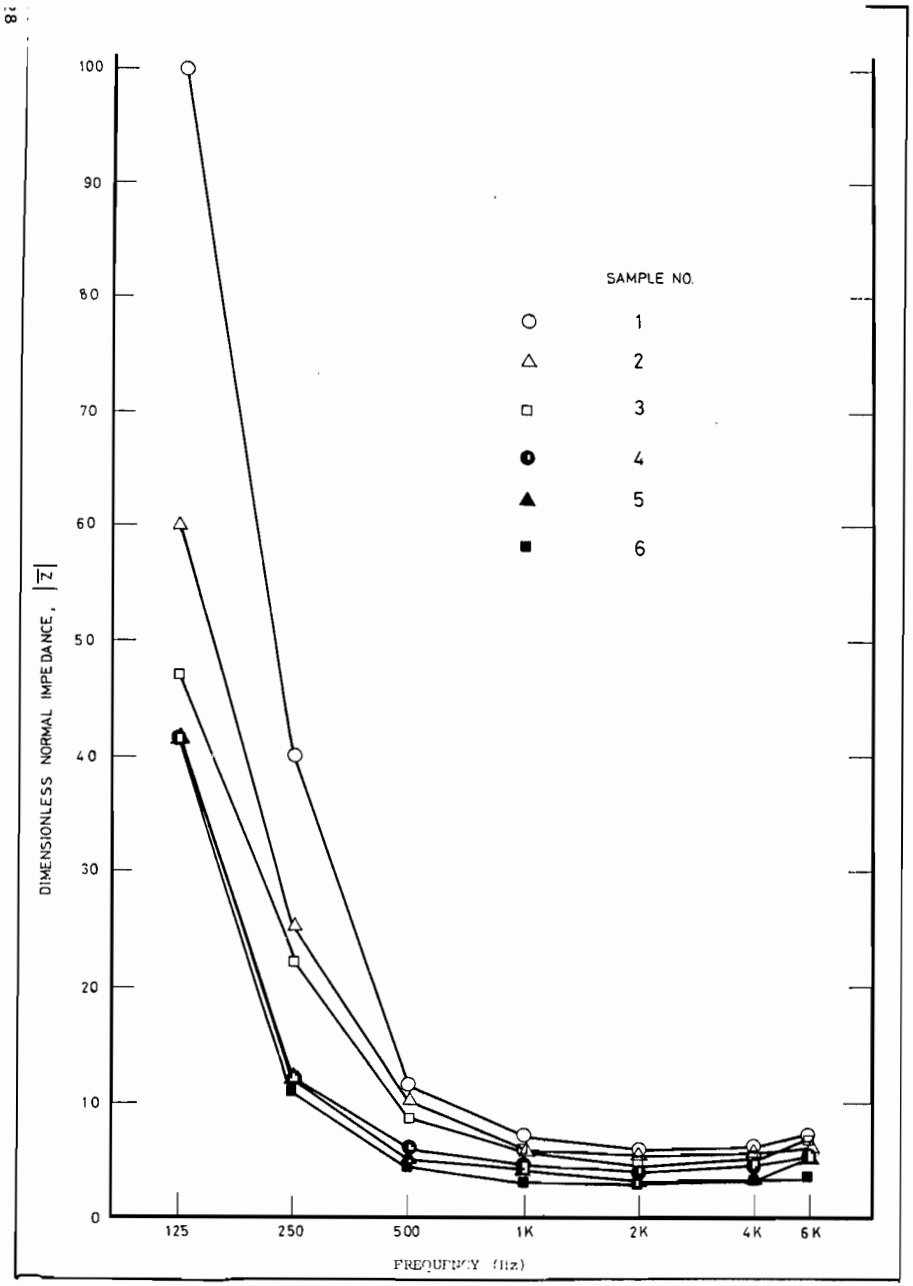

Fig. 2. Frequency Characteristics of Dimensionless Normal Impedance for Samples of Various Grain Sizes.

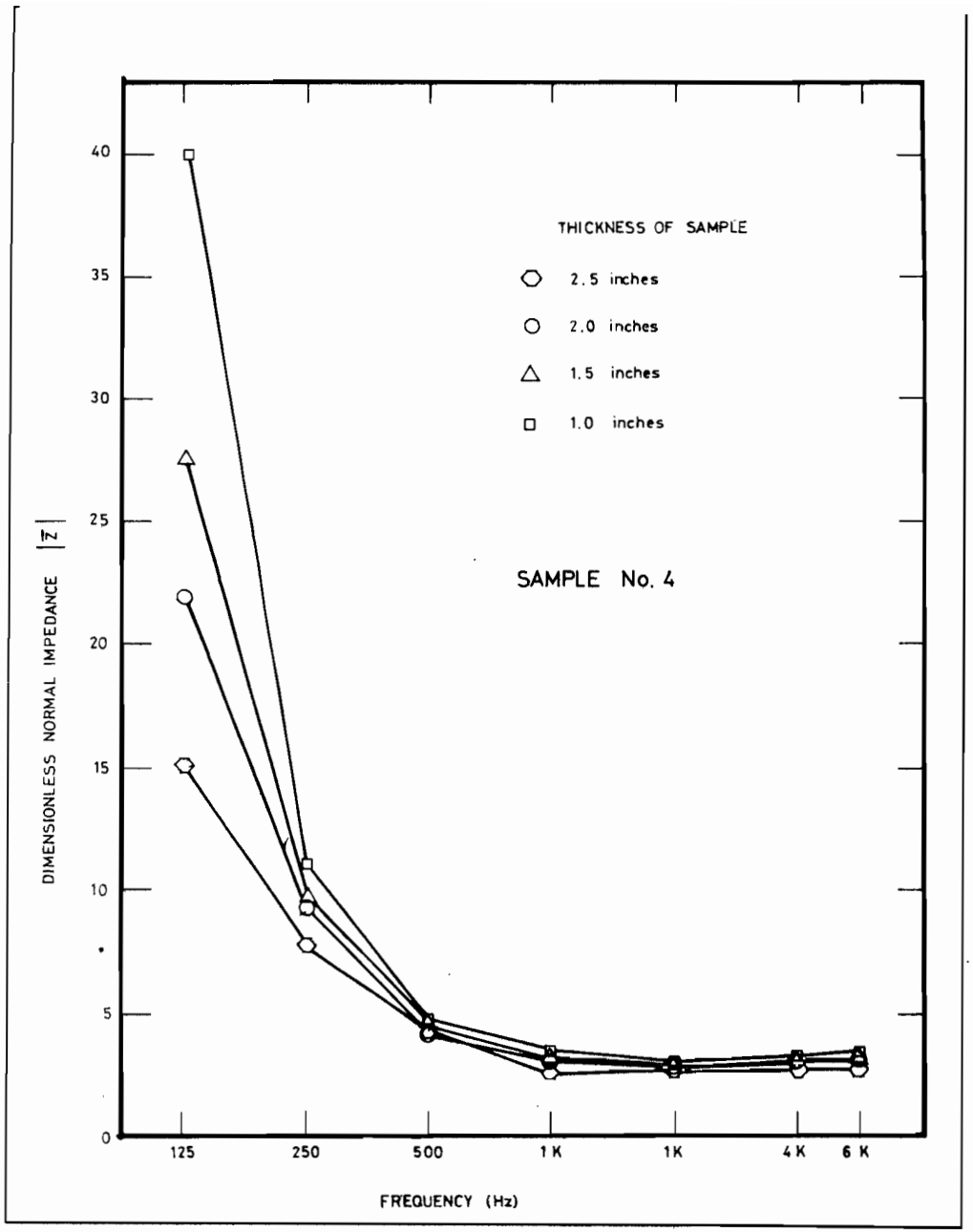

Fig. 3. Frequency Characteristics of Dimensionless Normal Impedance for Samples of Various Thicknesses.

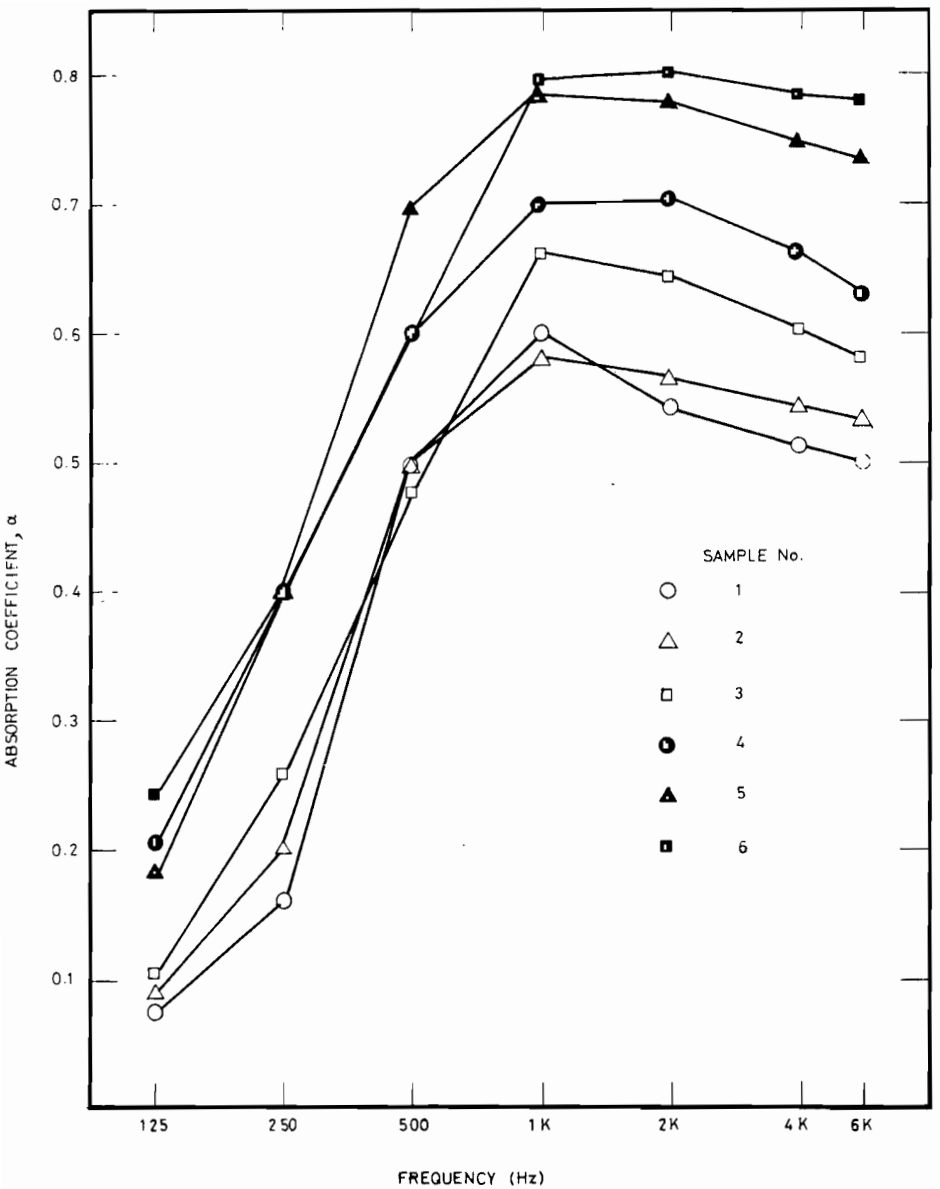

Fig. 4. **Frequency Characteristics of Sound Absorption Coefficient for Various Sample Sizes.**

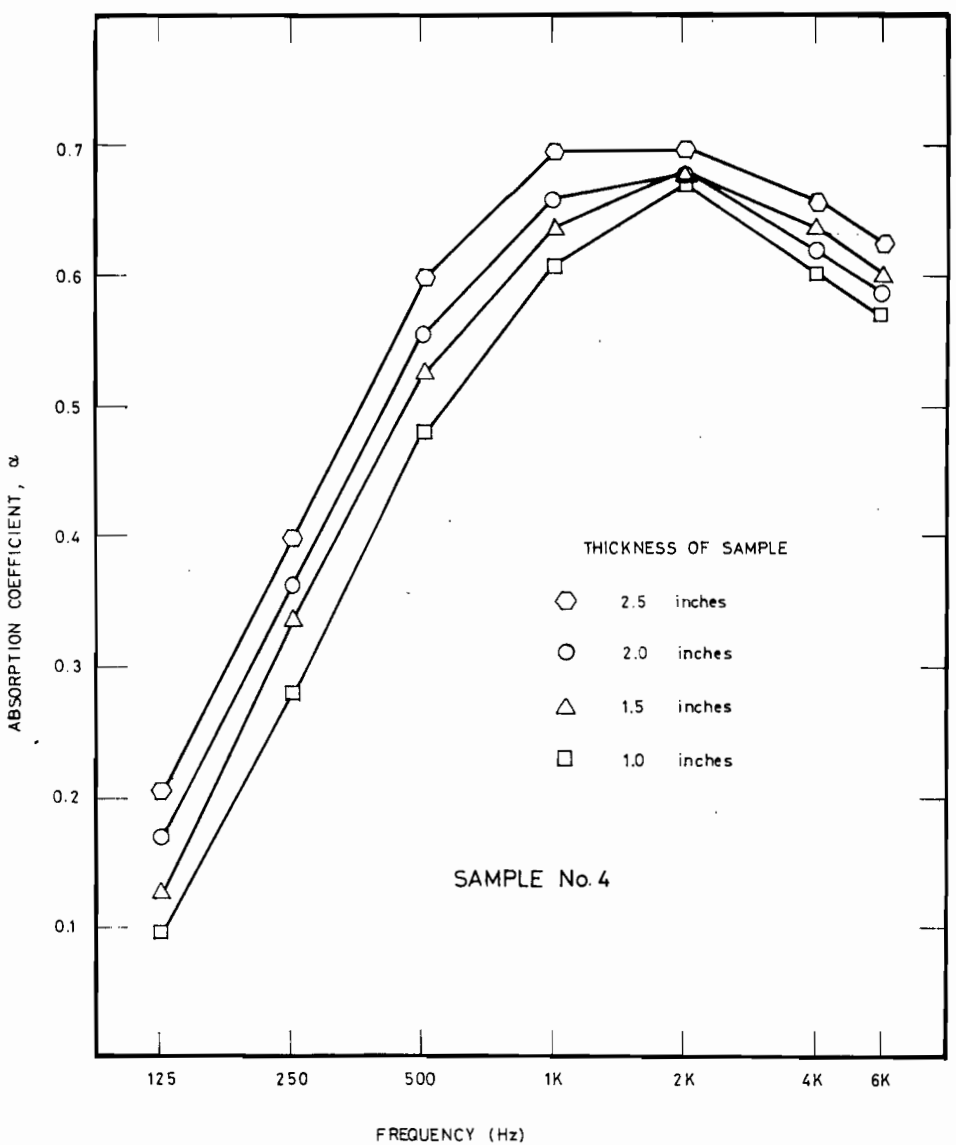

Fig. 5. **Frequency Characteristics of Sound Absorption Coefficient for Various Sample Thicknesses.**

A further analytic study and investigation is being undertaken to explain the behaviour and predict the performance of these materials, in order to assist the designer in the selection of suitable absorbers. This study will include both experimental (for determination of flow resistivity, porosity, and stiffness) and digital computation work.

ACKNOWLEDGEMENT

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NOMENCLATURE

ρ_o	density
c_o	speed of sound
Z	acoustic impedance
$\overline{Z}$	dimensionless acoustic impedance
α	absorption coefficient

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