THE BULLETIN

OF THE

AUSTRALIAN ACOUSTICAL SOCIETY

VOL. 1 NO. 1

AUTUMN 1972

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EDITORIAL

Last year, 1971, the Australian Acoustical Society entered a new and crucial phase in its existence. It seemed appropriate that the Newsletter of the N.S.W. Division, and other sporadic communications, should be supplanted by a publication of a more national character as befits the Society in its new Australia wide role. Accordingly, the Federal Council approved, at its November 1971 meeting, the establishment of the Bulletin, and although in this, the first issue, the beginnings may be humble, there are hopes that it can continue to grow in content and importance.

The policy proposed for the Bulletin is that it shall not seek to usurp, nor encroach on, the role of established journals.

There is a large volume of acoustical knowledge and "know how" available in Australia. Some of this could well be prepared as contributions to the regular acoustical journals and its dissemination is thus catered for. But there is much material which seems to lack any suitable outlet for publication. This latter is just what the Editor seeks, as technical articles for the Bulletin. Certainly, some of this information is shared at our technical meetings and by casual discussions. But circulation via the Bulletin will ensure that it becomes available to all members.

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The present proposal is to publish the Bulletin four times a year, in summer, autumn, winter and spring, and that initially alternate issues will be produced by the N.S.W. and Victoria Divisions.

The Bulletin seeks also to create a medium for discussion and comment on any matter thought relevant by members, however brief. For this it envisages a "News and Notes" section, wherein members can express an opinion, make a comment, assail a viewpoint, or simply inform others on matters which they feel to be of importance.

The first issue has been fortunate in having had contributed both a main technical article and a technical comment on the subject of that article.

An important point must be made, one that has been made many times before by others in similar circumstances. This is that the Bulletin can only be as effective as the Society whose views it expresses. To flourish, the publication must be able to rely upon the support of all members, otherwise, though a few may be able to sustain it for a while, its collapse is inevitable.

On this subject of support this first issue of the Bulletin should not allow the valuable assistance afforded the Society by its Sustaining Members to pass without recognition. They have provided their assistance ungrudgingly in very many ways, although perhaps the most obvious form has been in making available the services of valuable members of their staffs for the organisation of conferences and allied activities of the Society. The Society's Sustaining Members are listed in the front of this Bulletin.

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A.A.S. ACTIVITIES

1972 CONFERENCE "NOISE LEGISLATION & REGULATION"

Organisation has already commenced for a conference to be held at the Hotel Florida, Terrigal, N.S.W. during the six-hour day long week-end of Saturday 30 September, Sunday 1 October and Monday 2 October, 1972.

Although it is early days for the organisers, precluding them from outlining even a tentative programme at this stage, the basic decisions have been made that (1) the conference will be held on that long week-end, and (2) the theme is to be that of the control of noise by legislation and regulation.

There appears every likelihood that 1972 will see moves of far-reaching significance in the field of noise legislation. For this reason the conference should be of considerable importance to many members, who in numerous ways could feel the impact.

The action to be taken now is to note that the October long week-end is committed.

The organisers hope that the conference can be made a family affair, with opportunities for all to enjoy a week-end away on the N.S.W. central coast.

INTERNATIONAL CONGRESS ON ACOUSTICS

The president of the Australian Acoustical Society, Mr. H. Vivian Taylor, and the chairman of the N.S.W. Division, Mr. J. Rose, attended the 7th International Congress on Acoustics

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in Budapest during August 1971.

An important purpose of their attendance was to support a submission of the Society to this meeting of world societies that Australia be made the venue for the 1977 or 1980 congress. Although no decision was reached as to where the congress would be held during those particular years a reasonably favourable response was obtained.

Our delegation was praised for its presentation of the case to hold an I.C.A. in Australia, and it was given the opportunity to dispel doubts which were held, such as the nature of the weather which might be expected here during the European Summer, the cost and time involved in travelling so far, and the amount of acoustical activity in the area.

The envoys gained the impression that on the short list for 1977 were Spain, the Latin American Society, and Australia. However, as the I.C.A. for 1974 will be in England, and the policy is never to hold two successive meetings in countries with the same language, it was considered unlikely that Australia would be awarded the congress in 1977.

A committee has been formed to prepare a submission to the I.C.A. Council at its meeting in May 1972, when it is hoped a decision favourable to Australia will then be reached.

High commendation is given to Qantas and to Mr. Peter Galvater of that airline for the assistance given to the discussions at Budapest. Authoritative answers were always available to the many queries raised by the I.C.A. Council in regard to accommodation, bookings, and travel arrangements generally.

TECHNICAL MEETING

It is usual each year for the Society to hold a major conference. Last year, of course, the Victoria Division provided the centre-stage attraction with its very successful conference in March, at Warburton. The reverberations from that event are still being felt, both on the serious side and on the light. Frequent reference is made to the content of the papers wherever acoustics is discussed, and the strange happenings which took place outside the conference room seem to find their way inevitably into the conversation on social occasions.

In the absence of a conference in N.S.W. in 1971, the Technical Programme Sub-committee organised a special technical meeting, at which the guest speaker was Professor R.B. Lindsay, Dean of Graduate School, Brown University. The occasion was officially listed as an Annual get-together for members, wives and guests, and took the form of a dinner at the Wentworth Hotel on 16th September, 1971. The function was well attended, the dinner was good, and Professor Lindsay's historical account of the growth of acoustics was most interesting.

WESTERN AUSTRALIA DIVISION

As it goes to press the Bulletin is pleased to announce that the group in Western Australia interested in acoustic has requested the Federal Council to enable it to become a Division of the Australian Acoustical Society. The Division to be formed will take over the assets of the Western Australian Acoustical Society which will cease to exist on 31 March, 1972.

A hearty welcome to the West.

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NEWS AND NOTES

ACOUSTICS STANDARDS

Work on acoustics standards has advanced noticeably in recent months with several meetings held by the technical committees concerned with instrumentation and techniques for measurement, architectural acoustics, and community noise. Committee deliberations have probably crystallised most in the case of the proposed recommended practice for noise assessment in residential areas. Presumably because of the importance of the proposed recommendations to a wide range of interests, a great volume of comment was received as a result of the issue to public review of the proposals. The comment was considered at a recent two-day meeting of the large group constituting committee AK/5. After considerable discussion of the comment, and further comment on it and on the documents themselves, the draft recommendations were advanced to a stage where, after processing of all modifications, they can be issued for postal ballot.

A partial revision of I.S.O. R140 "Field and Laboratory Measurement of Airborne and Impact Sound Transmission" has been undertaken by I.S.O. Comments on the revised text were made by members of the Architectural Acoustics (AK/4) Committee of S.A.A., and these were forwarded to the I.S.O. Secretariat.

COMMUNITY NOISE IN THE NEWS

Under the catchy heading of SSSHHICAGO the columns on environment in TIME news magazine for 11 October, 1971, report

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on the early effects of the recent approval by the Chicago City Council of the "toughest anti-noise code in the U.S.". The news item states that, in the eleven weeks since the code was adopted, "the city-wide crusade for quiet is off to a good start" and that "environmental officers have swarmed through business and residential areas recording violations on sensitive decibel meters." Although offenders are liable to penalties as high as $500 plus six months in goal, the officers are said to be aiming to correct most offences rather than penalise offenders.

EDUCATION

To meet the growing need in the community for graduates with a special knowledge of acoustics, the University of New South Wales will inaugurate in 1972 a post-graduate course of Master of Science (Acoustics). The course will be conducted jointly by the Schools of Architecture, Mechanical and Industrial Engineering, and Physics. As proposed, there will be four sessions to be studied over two years on a part-time basis. Prior to commencement of these sessions, candidates will be required to complete successfully a qualifying year, also to be undertaken part-time. Candidates holding the degree of B.Sc (Arch) will have to complete in their qualifying year the subjects Vibration and Wave Theory 1 and 11, Computer Techniques, and Experimental Techniques, whereas those holding degrees of B Arch., B. Build. Sc., B Sc., or B E, may have to complete some of these and some other qualifying subjects. In the final two sessions

options are available which allow for specialisation in such fields as noise control in buildings, engineering noise control, and theoretical aspects of acoustics.

Full details on the qualifying requirements, and on the subjects making up the four sessions of the course proper, are now available from the University.

CLOSING DATES FOR PUBLICATION

Winter issue (Victoria Division)	Technical Articles	1 May 1972
	Letters to the Editor	14 May 1972
Spring issue (N.S.W. Division)	Technical Articles	1 Aug. 1972
	Letters to the Editor	14 Aug. 1972
Summer issue (to be decided)	Technical Articles	1 Nov. 1972
	Letters to the Editor	14 Nov. 1972
Autumn issue (to be decided)	Technical Articles	1 Feb. 1973
	Letters to the Editor	14 Feb. 1973

INTERNATIONAL SYMPOSIUM ON THE ENVIRONMENT IN BUILDINGS

An international conference of likely interest to many is scheduled to be held at the University of Technology, Loughborough, Leicestershire, England, from 18 to 22 September, 1972. Information Sheet No. 1, recently received from the Symposium Secretary, advises that the conference, which is sponsored by the International Labour Office, will be an interdisciplinary symposium on the environment within buildings intended for human occupation in all parts of the world. Its stated aim is to achieve an exchange of ideas among professional people and scientists concerned with the provision of built environments, with the view to improvement in the design of these environments in terms of human requirements.

Offers of papers in certain categories are invited.

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TECHNICAL NOTES

AIR CONDITIONING DUCT LINERS
A NEW TEST FOR RATING ACOUSTICAL PERFORMANCE

J. A. Irvine

C.S.R. Building Materials Research Laboratories,

Concord, N.S.W.

SUMMARY

The local development work on a new "in duct" test for rating air-conditioning duct lining materials is described.

The superiority of the procedure over the impedance tube method previously in vogue is discussed.

The best method of presenting test results for the use of design engineers is considered. Some assistance from Australian specialists is requested.

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Historical

It has been recognised for many years that there is a need for a more direct way of predicting duct liner performance than by calculations based on absorption coefficients. This matter is discussed in some detail later; it will suffice to state now that an "in duct" procedure was given early consideration.

In Australia, Mr. G.A.B. Riley appears to have been the first to attempt the development of a practical test procedure, commencing work in his laboratories in Melbourne in December 1963. Quite independently, the writer carried out preliminary experiments in Sydney in January 1964. Each was given valuable guidance by Dr. W.K. Lippert of C.S.I.R.O.

At this early stage, the only overseas laboratory known to have worked on the problem was that of Dr. Sacerdote in Turin. By correspondence it was learned that no current work was in progress, nor likely in the near future.

Three years ago the development of an "in duct" test was placed on the agenda of the Architectural Acoustics Committee of the Standards Association of Australia. A sub-committee, consisting of Mr. G.A.B. Riley and the writer, was appointed to look into the matter.

By this time Mr. Riley had carried out a very considerable amount of development work, resulting in a practical test procedure. His method was based upon the use of twin reverberant rooms, connected by the test duct in which specimens could be installed. Ratings were in terms of the "insertion loss" of the particular system under examination (i.e., the reduction of

noise transfer from one room to the other produced by the presence of the specimen in the connecting duct.)

Through correspondence, the A.S.T.M. in the U.S.A. was now found to have taken up the problem, and although details were scanty it seemed that an "in duct" method was being considered. The A.S.T.M. method differed from that of Mr. Riley in employing only one reverberant room, into which noise from the duct was discharged for measurements. The noise source consisted of loud speakers feeding directly into the remote end of the duct-work.

At about this time (1969) some work carried out by the "Heating and Ventilating Research Association" in England came to notice. This group, in close liaison with the National Physical Laboratories in London, had carried out very thorough development of a test procedure for unit silencers. The result was a Test Code giving details of equipment and methods of measurements. Three ways of measuring the residual noise from the duct were recommended; (1) in duct with an anechoic termination, (2) in a semi-reverberant room to which the duct discharged and (3) in a fully reverberant room. In all cases the sound source was a bank of loudspeakers facing directly into the other end of the test duct.

Construction of Test Duct

It was decided that facilities along the lines of the British Test Code would be assembled at the Research Laboratories of C.S.R. Building Materials, at Concord West, Sydney. Some inquiries in London provided assurance that the test procedure,

while planned originally for unit silencers, could nevertheless be appropriate for the rating of lengths of lined ductwork. These same inquiries revealed that the Code was about to be issued as a British Standard.

The construction of the apparatus commenced early in 1971, and was made to conform exactly to the British Standard (B.S. 4718:1971) which was issued towards the middle of the year. Of the procedures laid down, the use of the anechoic termination for the test duct was chosen, largely on the grounds of convenience. The duct dimensions in use, (24" x 20"), are fairly typical of normal building practice. Provision is made for the installation of up to 16 ft. of duct lining material.

For full details of the test, reference should be made to the British Standard, obtainable through Standards Association of Australia. A sketch showing the main dimensions of the apparatus at C.S.R. is given in Figure 1.

Checks on Performance of Apparatus

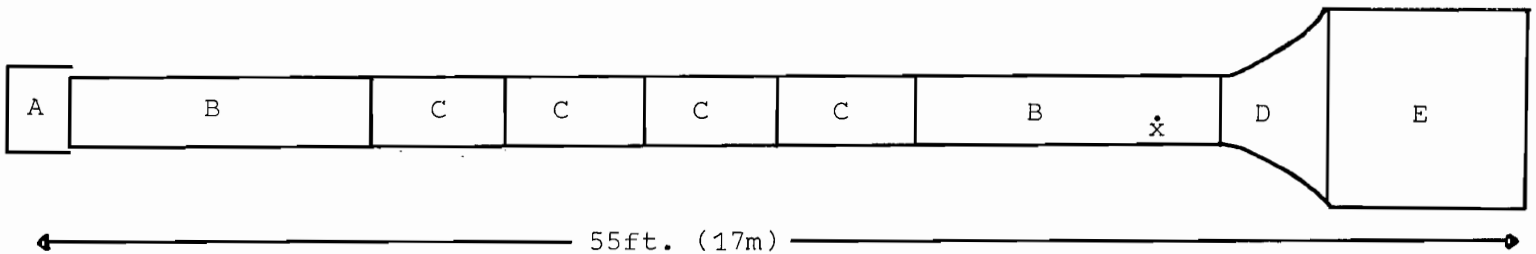
A number of criteria must be met in order to prove conformity with B.S. 4718:1971. Briefly, these are:

1. Measuring equipment must conform to the relevant Standards (B.S. 4197 and 2475).
2. The noise source shall consist of a bank of loudspeakers, connected in phase, and whose projected area shall be at least 40% of that of the duct.
3. The test duct shall be made using specified metal thickness, bracing, and lengths of isolating sections according

FIGURE 1.

DUCT TEST RIG

(Diagrammatic only)



A LOUDSPEAKERS

9 UNITS, EACH 6IN. (150MM) DIAM.

B CONNECTING DUCTS

SECTION: 20IN X 24IN (508MM X 610MM)
LENGTH : EACH 13FT. (4M)

C SPECIMEN HOLDERS

SECTION: 20IN X 24IN (508MM X 610MM)
LENGTH : EACH 4FT. (1.2M)

D COUPLER

LENGTH: 5FT. (1.5M)
SECTION: EXPANDING FROM
20IN X 24IN (508MM X 610MM)
TO 5FT. X 6FT. (1.5M X 1.8M)

E ANECHOIC TERMINATION

LENGTH : 6FT. (1.8M)
SECTION: 5FT. X 6FT. (1.5M X 1.8M)

X MICROPHONE POSITION

to shape and size of the cross section.

4. Ambient noise at the receiving microphone position (within the duct) shall be at least 6 dB below the signal level.

5. Flanking transmission must be checked by the installation of a high transmission loss barrier, and must be at least 10 dB below the transmission measured with test specimen installed.

6. The anechoic termination shall be shown to be adequate.

7. The measuring microphone shall be installed so as to sample the sound pressures correctly.

Curiously, no mention is made in B.S. 4718:1971 of the need to ensure a constant level of sound source throughout any one experiment. This is, of course, a vital requirement, and steps have been taken to deal with it.

All the criteria mentioned above have been met. Only one will be discussed here in any detail - the matter of flanking transmission.

A series of tests was carried out using various means of blocking sound transmission along the duct. The carriage of sound along the duct walls, in the form of vibration, was found to be significant, especially at low frequencies. Some reduction of this mode of flanking was noted when a considerable length of specimen was installed. However, the effect was noted only at the lowest sound frequencies (63-125 Hz).

We considered that the most realistic check on flanking was obtained by lining 16 ft. of the duct, and then adding further transmission loss by totally filling 4 ft. of this with duct lining material.

The results of this test were as follows:

Table 1

	Insertion Loss							
Freq. in Hz	63	125	250	500	1K	2K	4K	8K
16 ft. lined	2	2	5	18	45	22	17	12
16 ft. lined plus 4 ft. filled	11	23	28	43	46	54	64	55

It will be noted that, for the particular material tested (a regular 1 in. lining), the 10 dB margin laid down by the Standard is met at all frequencies except 63 Hz and 1 KHz. A shorter length of test specimen would clearly be needed, and subsequent work showed that no more than 8 ft. could be used, if the criterion were to be met.

Enhanced performance of lined duct sections can be obtained by using resilient sections for vibration isolation, as we found by direct experiment. We plan later to study this further.

We have obtained NATA registration for this test procedure.

Comparison of Rating Systems

The rating of duct liners by the new test has been compared with the absorption coefficient obtained by impedance tube. The latter is the form of test currently in use in Australia

for duct liners.

In the Table 2 below, test results are shown for three types of material commonly used as air-conditioning duct liners. All are of 1 in. thickness, and mounted in exactly the same way.

Table 2

Specimen	Absorption Coefficient by Impedance Tube				Insertion loss by B.S.4718: 1971	Density in lbs/ft^3
	250 Hz	500 Hz	1KHz	2KHz		
A	0.10	0.19	0.32	0.49	10.3dB	1.5
B	.13	.21	.58	.85	10.3	6.1
C	.21	.50	.86	.93	10.4	3.2

Note: The values for insertion loss are the average over all test frequencies from 63 Hz to 8 KHz, using an 8 ft. long test specimen.

Clearly, neither the absorption coefficient measured in this way, nor the density, can be taken as useful guides to the performance of a material when it is installed in a real duct.

Expression of Results

While B.S. 4718:1971 seems to offer a satisfactory measurement procedure, there remains the problem of how best to express duct liner performance to provide a guide to engineering design.

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In particular, the following matters seem worthy of study:

1. Specimen length

   From the measurements we have made so far, it seems that a rating based upon attenuation in dB/foot run would not be satisfactory. Increasing the length of specimen may not necessarily cause a proportional increase in the measured insertion loss. This is quite independent of flanking effects.

2. Duct Dimensions

   So far, all our work has been carried out in one size of ducting. Certainly, other sizes must be used too, in order properly to gauge the effect of this factor.

3. Duct Wall Vibration

   Flanking caused by vibration travel along the duct walls does not allow the full potential of duct linings to be exploited, especially at the lower frequencies (63 Hz to 250 Hz).

   It may thus be worth while to run additional tests on materials, under conditions where vibration travel is limited by a resilient section in the test duct.

We are now carrying out a series of tests designed to solve the problems discussed above. Additional items of duct work, including pieces with smaller and larger cross section, and bends for all the sizes of test ducts, are being obtained. Further examination of vibration breaks is under way.

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In addition, we are conferring with acoustical consultants in order to be sure that a generally acceptable rating system is developed. Suggestions from any source would be welcome. We have sought overseas advice, but without useful results so far. It is important that by the time the B.S. 4718:1971 has received public review in Australia we should be able to draw up a document which completes this task of providing acceptable ratings for commercial duct liners.

Australia appears to have the opportunity of being the first country to issue such a Standard; let us make sure that it is good enough for acceptance world-wide.

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TECHNICAL DISCUSSION

SOME REFLECTIONS ON THE DUCT LINER TEST

P. R. Knowland

When the editorial sub committee received J. Irvine's excellent article on the duct lining tests, it was thought an opportune time to study the existing state of the art. Accordingly, several acoustic consultants in Sydney were asked to predict the theoretical performance of a 16 ft. length of duct of the size of, and lined in accordance with, the test section used by C.S.R. The results were submitted and, unfortunately, the Bulletin did not offer any prizes for the neatest, correct entry. Nevertheless, red faces, mine included, were their own rewards when the measured results were revealed.

In Fig 1 the various predictions have been plotted and are compared to the actual results obtained by the C.S.R. Generally, the predictions of people using Sabine (or Sabine derived) equations tended to be conservative, as against predictions from the Morse (Cremer) equation. The latter are a little on the optimistic side, as evident from the patterns in Fig 1.

It has been known for some time that Sabine's equation was conservative, but it has been felt that the work of Morse, Cremer and Ingrad provided a more accurate approximation of the

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attenuation of duct lining. The question arises whether the curves for the Morse (Cremer) equation are optimistic over the entire frequency range. When the C.S.R. results are corrected for flanking the results at 1000H_z and 2000H_z agree with, or slightly exceed the prediction. Therefore the main question, and an important one in terms of duct attenuation, becomes whether the Morse equation is optimistic in the low frequency range.

Fig 2 compares the attenuation of 8 ft. of lined duct with that of an 8 ft. long low-resistance splitter-type commercial package attenuator. The shape of the attenuator's measured performance and the lined duct are very similar, but displaced because of the overall higher performance of the commercial attenuator.

There seems no doubt as to the general shape of the attenuation curve for the duct liner. Thus, the question arises as to why the Morse (Cremer) equation predicts higher performance in the low frequencies compared with actual values. Obviously there is the need for some local research to examine this situation.

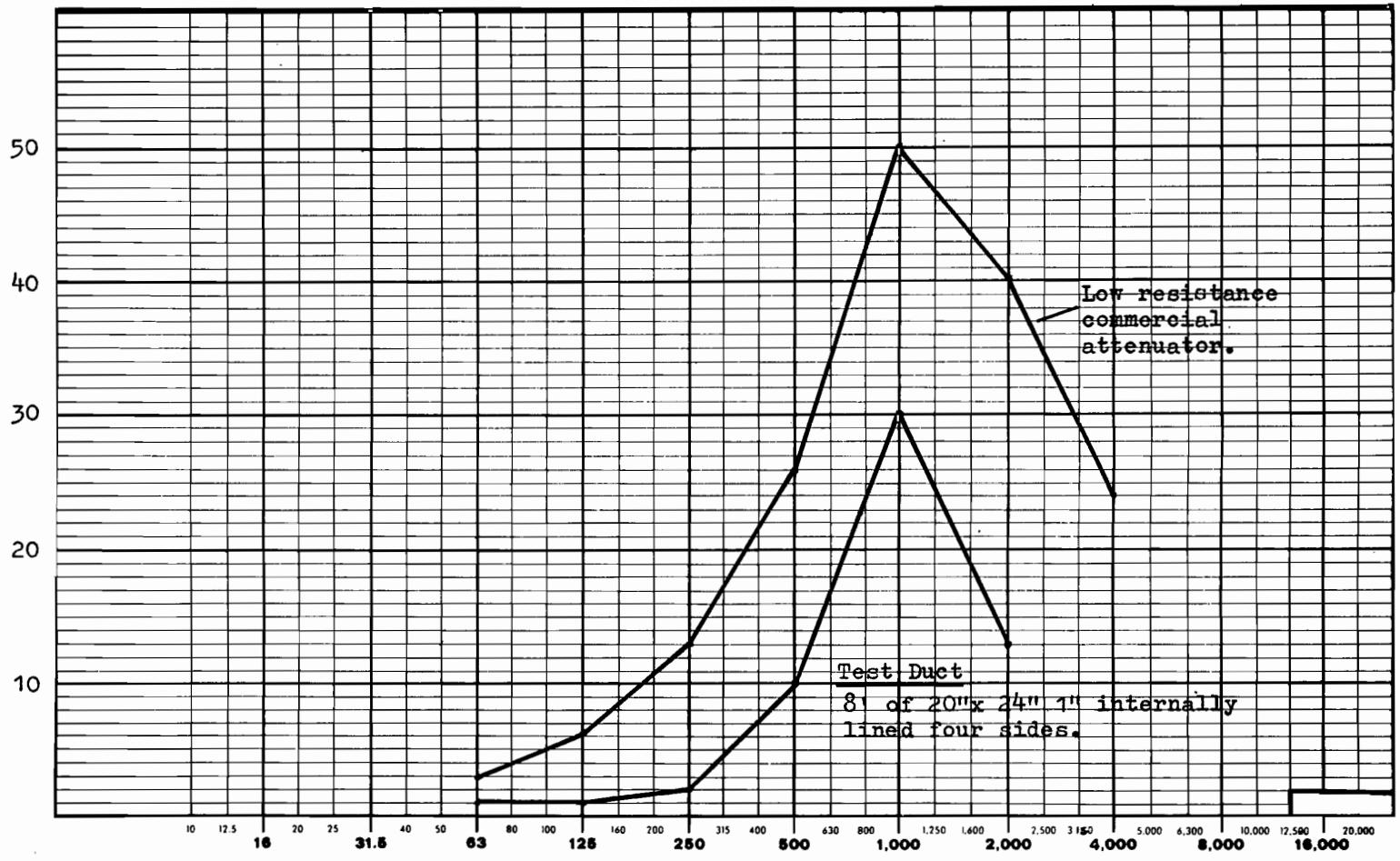
Attenuation in Decibels
50
40
30
20
10
Low resistance commercial attenuator.
Test Duct
8' of 20"x 24" 1" internally lined four sides.
10 12.5 16 20 25 31.5 40 50 63 80 100 125 160 200 250 315 400 500 630 800 1,000 1,250 1,600 2,000 2,500 3,150 4,000 5,000 6,300 8,000 10,000 12,500 16,000 20,000
OCTAVE BAND CENTRE FREQUENCY (CYCLES PER SECOND)

FIGURE No. 2

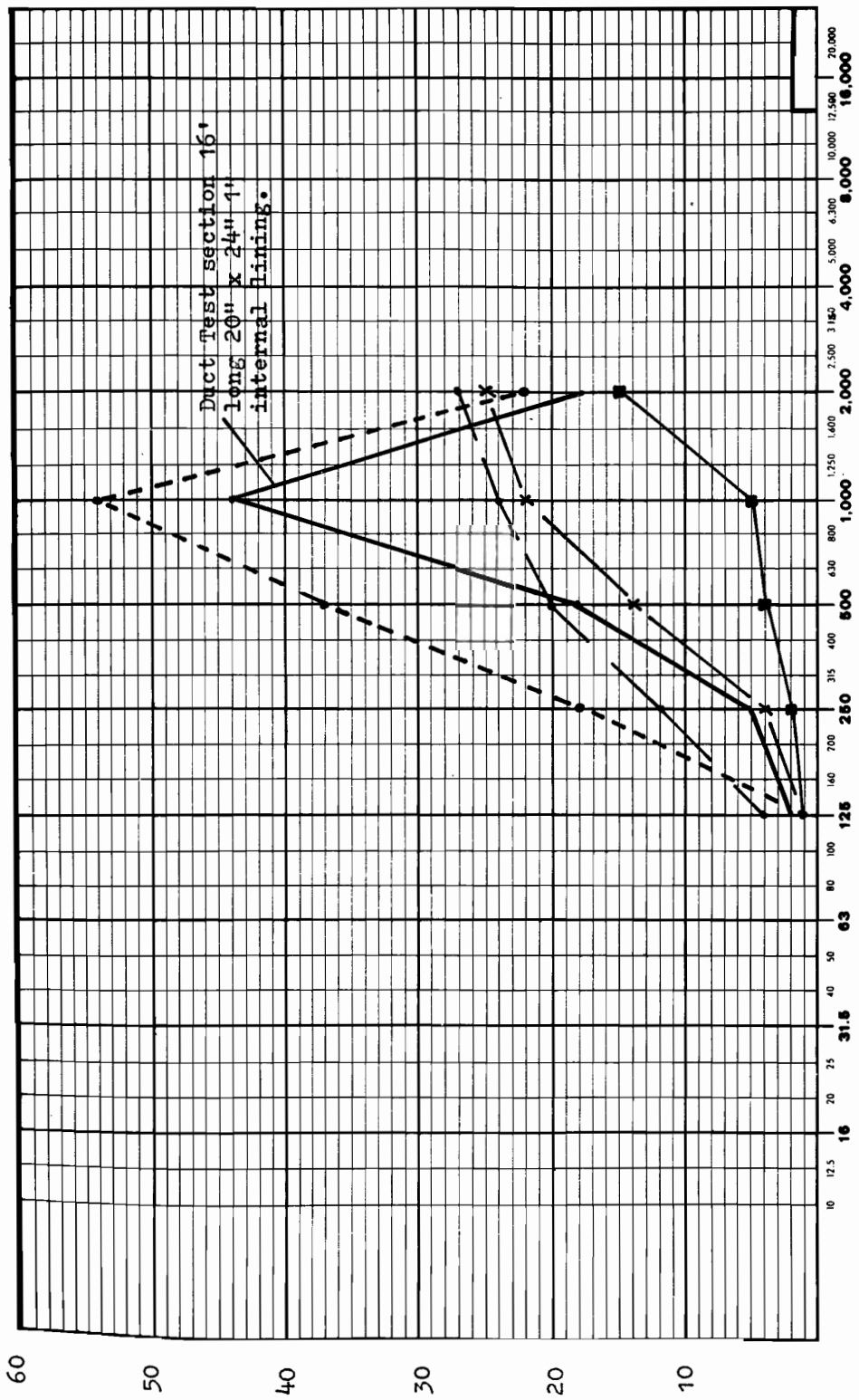
Duct Test section 16'
long 20" x 24" 1"
internal lining.
ATTENUATION IN DECIBELS
60
50
40
30
20
10
10
12.5
16
20
25
31.5
40
50
63
80
100
125
160
200
250
315
400
500
630
800
1,000
1,250
1,600
2,000
2,500
3,150
4,000
5,000
6,300
8,000
10,000
12,500
16,000
20,000
OCTAVE BAND CENTRE FREQUENCY (CYCLES PER SECOND)

FIGURE No. 1

SOCIETY COMMITTEES

The composition of the Society Committees is listed here for the interest of members:

FEDERAL COUNCIL

H. Vivian Taylor	President
P.R. Knowland	Vice President
J.F.M. Bryant	Secretary
J.A. Irvine	Treasurer
Professor R.G. Barden	
G.E. Harding	
Mrs. A.B. Lawrence	
J.A. Madden	
G.A.B. Riley	
J.A. Rose	

N.S.W. DIVISION

J.A. Rose	Chairman
R.C. Wilkinson	Vice Chairman
Mrs. A.B. Lawrence	Secretary
J.A. Irvine	Treasurer
G. Kimpton	
P.R. Knowland	
J.A. Madden	
G.C. Pickford	
R.A. Piesse	
E.T. Weston	

VICTORIA DIVISION

Professor R.G. Barden	Chairman
G.A.B. Riley	Vice Chairman
G.E. Harding	Sec./Treas.
J.F.M. Bryant	
A.C. Clutterbuck	
P. Dubout	
J.R. Martin	
H. Vivian Taylor	
J.G. Twiss	
Professor A. Williams	