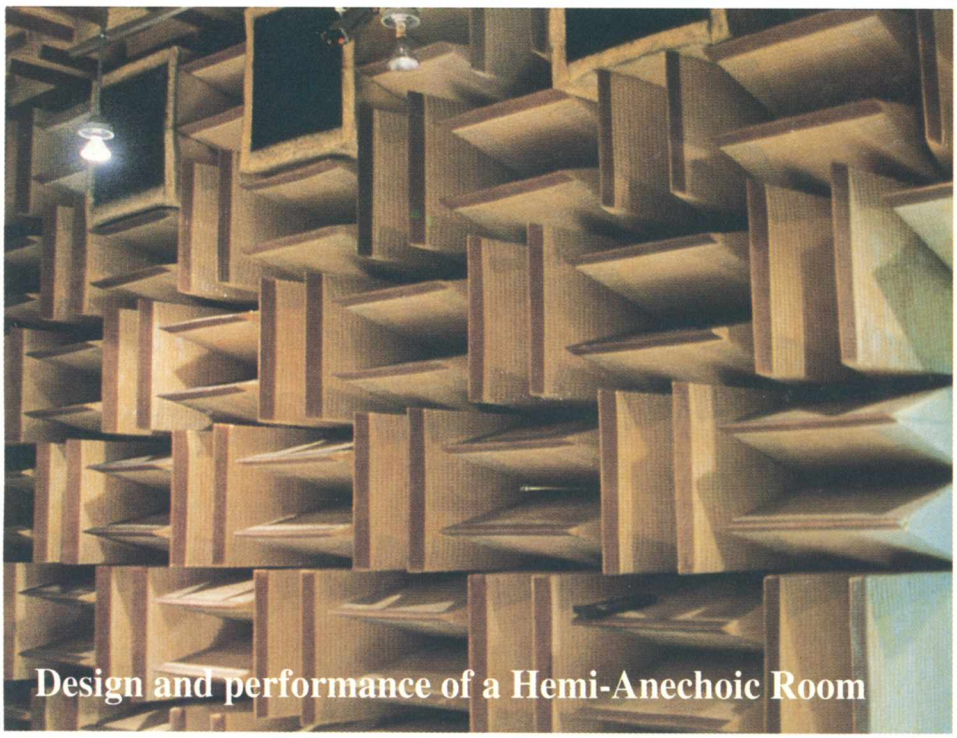
NOISE/NEWS INTERNATIONAL

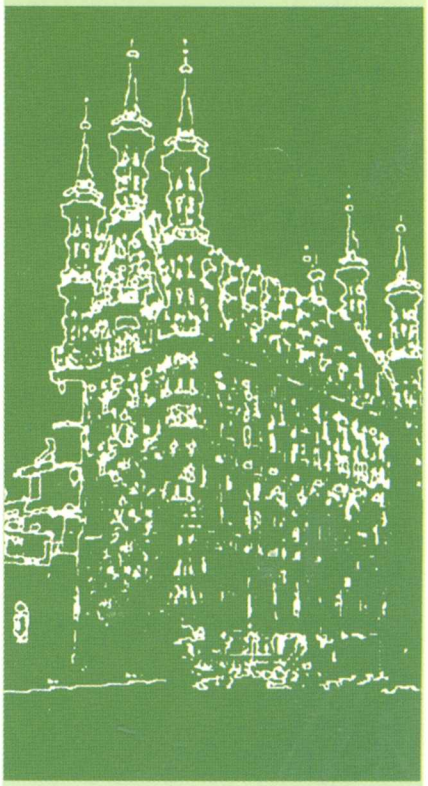
A quarterly news magazine

Volume 1, Number 1
1993 March



Design and performance of a Hemi-Anechoic Room

Plus



inter·noise 93

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- **Paper titles**
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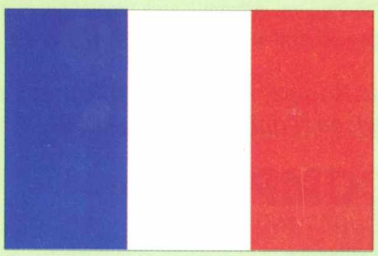

Member Society Profile:
The French Acoustical Society

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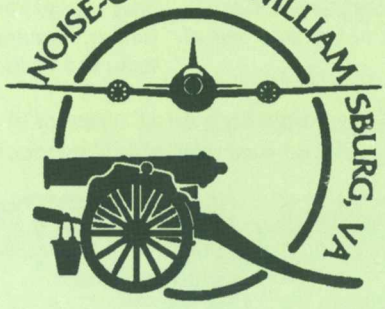

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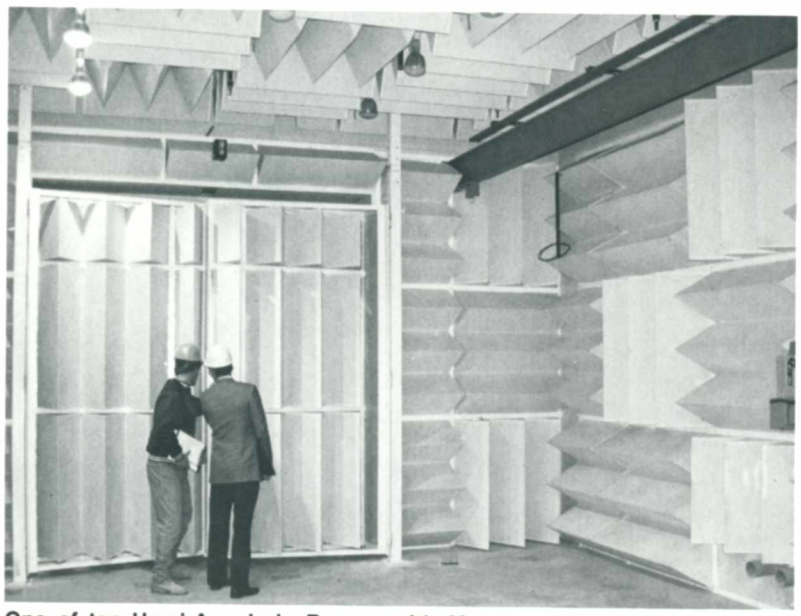

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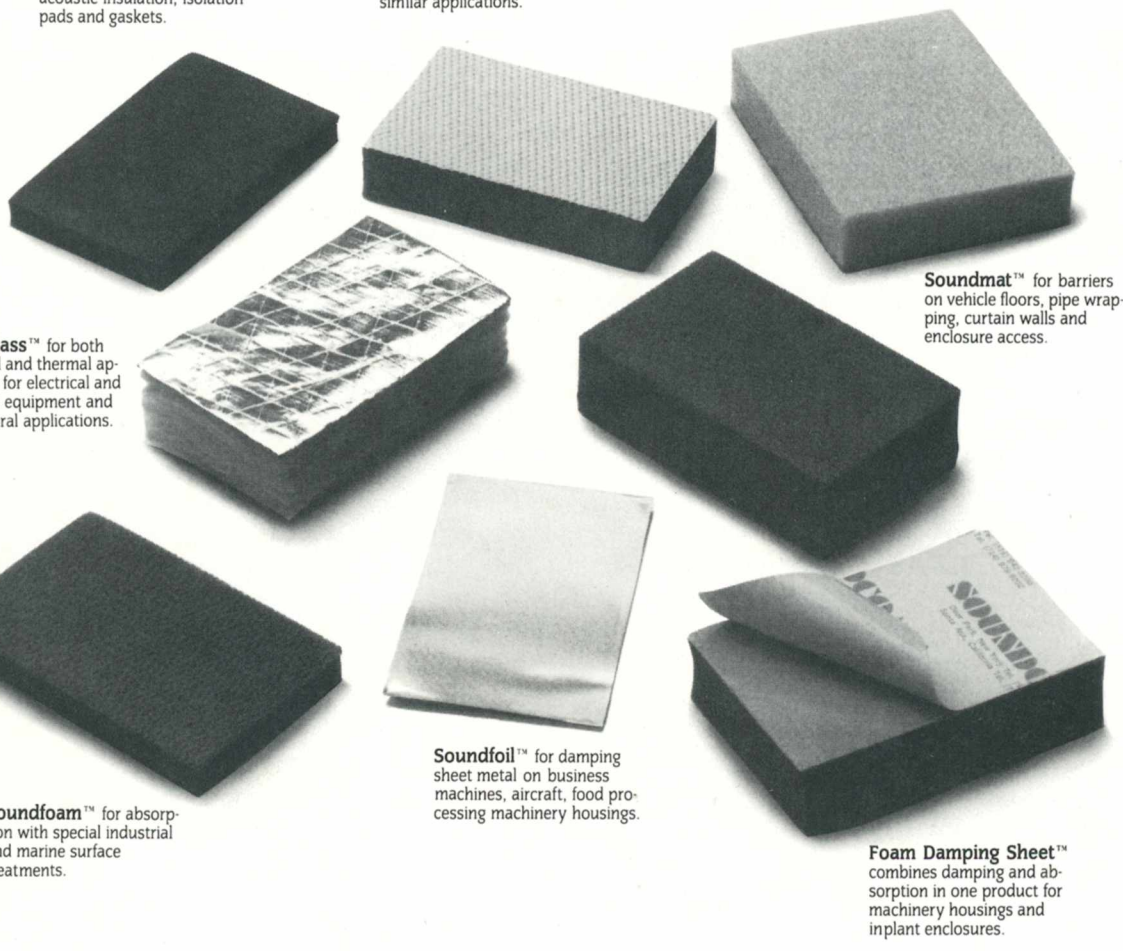

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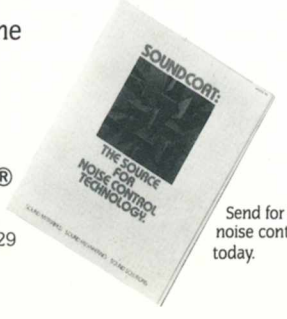

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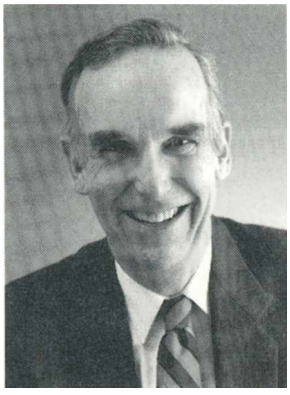
President's Corner



NNI, A New Newsmagazine!

With this first issue (Volume 1, Number 1) of *Noise/News International*, the reader is welcomed to a new publication. NNI is the successor to two newsletters, *Noise/News* of the Institute of Noise Control Engineering of the U.S.A. (INCE/USA), and the Newsletter of the International Institute of Noise Control Engineering (I-INCE).

In a companion editorial in this first issue, Pan-American Editor George Maling has sketched the history of *Noise/News* since its inception in 1972. The I-INCE Newsletter was started three years later and has been published continuously since 1975, a total of 68 issues being distributed over the years.

On 1974 September 30 at the opening session of INTER-NOISE 74 in Washington, D.C., U.S.A., Professor Fritz Ingerslev of Denmark, the Charter President of International INCE, announced the formation of the new non-profit Institute, which was chartered under Swiss civil law. From the inception of the Institute until the end of 1980, the positions of I-INCE Secretary-General and Newsletter Editor were ably filled by Professor Eric Rathe of the Federal Institute of Technology (ETH), Zurich, Switzerland. In 1975, he took the initiative to launch the Newsletter as a vehicle "...intended to provide an international exchange of information on all aspects of noise control engineering. This includes information on INTER-NOISE conferences sponsored by the Institute, and on the development of international standards by ISO and IEC.

"Proceedings of other international and national meetings, and other publications and reports submitted to the Institute can also be covered. The developments in the field of national laws and regulations are of particular interest." The publication policy first defined by Prof. Rathe was continued during the decade of the 1980s, and, indeed, will be assumed by this new publication.

At the beginning of 1981, the central secretariat of International INCE was transferred from Switzerland to Belgium when Professor Henry Myncke succeeded Professor Rathe as the I-INCE Secretary-General. Dr. André Cops assumed the editorship of the I-INCE Newsletter at that time.

Editor Cops provided editorial leadership to the I-INCE Newsletter from 1981 through the end of 1992. During this period, 47 issues of the Newsletter were published. This was a turbulent period in the world, and Editor Cops performed outstanding service to International INCE by providing an excellent vehicle for international communications. With the advent of this new publication, Professor Cops assumes the key role of European Editor.

Noise/News International will have everything offered by the newsletters that it succeeds, and more. Some of the new features of *NNI* are a Member Society profile, a feature article of general interest, a feature on people in the news, a section on product news and a world conference calendar.

It is a pleasure to welcome readers to this new addition to the global publication scene, which will provide an expanded coverage of the latest world news about noise and its control.

— William W. Lang,
President International INCE

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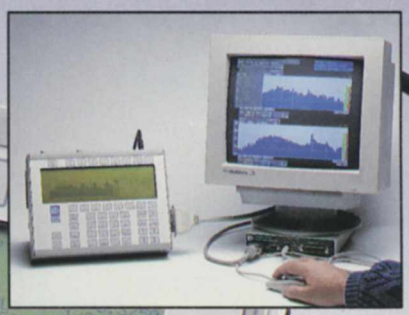

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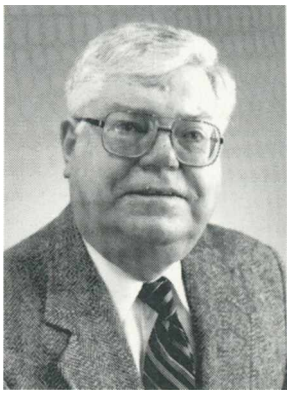
Editor's View

The Launch of a New International Publication



When discussions began in the United States in mid-1970 about the founding of the Institute of Noise Control Engineering (INCE/USA), it became clear that the organization would need to have a means of communicating with its members. In the spring of 1971, I offered to become the editor of a new newsletter, tentatively titled *Noise/News*, which would serve as the vehicle for such communications. INCE/USA was formally incorporated in 1971 July, and plans for the new publication were put in place later in the year. The first issue of *Noise/News* was distributed at the second Arden House Workshop on Noise Control Engineering which was held in 1972 January and which marked the formal beginning of INCE/USA.

Noise/News covered the development of the technical program for INTER-NOISE 72 during 1972, and when, a few weeks after INTER-NOISE 72, the 92nd Congress of the United States passed the Noise Control Act of 1972, the need for a means of communicating between noise control engineers became even more important. The U.S. Environmental Protection Agency (EPA) was assigned the task of implementing the Act, and the newsletter focused on EPA activities during the 1970s and early 1980s. During the last 20 years, *Noise/News* has regularly covered the INTER-NOISE series of congresses, and other meetings in the USA.

As the editor of *Noise/News*, I have cooperated with the editor of the newsletter of International INCE since that newsletter was founded in 1975 as the communications medium for I-INCE, and some of the same information has regularly appeared in both publications. Late last year, the Board of Directors of INCE/USA empowered me to restructure *Noise/News*, and to work with the Institute of Electrical and Electronics Engineers (IEEE) to produce a new publication. The IEEE Magazines group has an interest in assisting other engineering organizations with development of publications in their own disciplines, and now seems to be the time to accept this assistance. Further discussions with Professor André Cops, editor of the I-INCE newsletter, lead to the development of a new magazine titled *Noise/News International*, which will now be distributed to the Member Societies of International INCE and to the members of INCE/USA.

There is no doubt in my mind that this new magazine will be much stronger than either of the previous newsletters. We have available to us the talents of the IEEE Magazines staff available for composition, layout, and advertising, the ability of Dr. Cops to cover news from Europe, and the resources to cover activities in the United States and the rest of the world. This new publication will continue to cover the INTER-NOISE series, and many of the departments in *Noise/News* will continue.

We plan to broaden our coverage of the activities of the Member Societies of International INCE, and to continue to provide information about the activities of INCE/USA. We plan to have at least one tutorial or general interest article in each issue, and to have a more coherent structure than existed in either of the previous two newsletters.

The launch of a new publication is an exciting time for all involved, and we are anxious to provide an English-language publication that will serve all of the Member Societies of International INCE. I am pleased to be associated with this new venture, and I hope that our readers are pleased with the results of our efforts.

— George C. Maling, Jr.
Pan-American Editor

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The French Acoustical Society (S.F.A.)

Created in 1948 as the Group of French-speaking Acousticians (G.A.L.F.), the French Acoustical Society (S.F.A.) has as its objectives: to develop and circulate scientific and technical information, to foster the interdisciplinary character of acoustics, and to act as a focal point for all French-speaking acousticians. The S.F.A. has a membership of about 1400, drawn from varying backgrounds with varying interests (engineers, researchers, teachers, biologists, architects, lawyers, psychologists, physicians, etc.) and from all kinds of professional activity (administration, industry, academia, etc.). Its members, who come from many other countries as well as France, are organized in specialized groups according to their particular interests within the broad field of acoustics: musical acoustics, hearing, speech communication, ultrasonics, measurement and signal processing, architectural acoustics, electrodynamics, industrial and environmental acoustics, and aero acoustics.

The means by which S.F.A. attempts to achieve its objectives are threefold:

- Acoustics is promoted by the dissemination of information, including the publication of papers, articles and books describing the research work of its members, and the encouragement of working relationships between acousticians and others interested in the field of acoustics, in France and abroad. For the past 5 years, the S.F.A. has published the *Journal d'Acoustique*, a publication in French and English which appears bimonthly.

- Training that enables students to benefit from the most recent advances in acoustics research. For this purpose, the S.F.A. fosters many kinds of teaching, including fundamental courses as well as continuing education. The educational programs of S.F.A. are published periodically in a special booklet.

- The dissemination of knowledge and research results are emphasized by sponsoring scientific meetings and conferences, carrying out investigations and supporting publications, as well as by taking part in standardization activities. International exchanges are encouraged, and foreign researchers are honored for their work.

The S.F.A. has established working relationships with national acoustical societies, including those of Belgium, Poland, Italy, Great Britain, Germany, Spain, U.S.A., Latin America, Switzerland, China, etc. These relationships have facilitated many types of exchange: joint sponsorship of conferences, exchanges of articles in national publications, invitations to leading acousticians, etc. The S.F.A. took an active part in the creation of the European Federation of Acoustics (F.A.S.E.), which was established in 1972, and in 1975, the S.F.A. sponsored the first F.A.S.E. scientific congress. In 1983, the S.F.A. organized the 11th International Congress on Acoustics. The S.F.A. also took an active role in the creation of the New European Acoustics Association. It organized the 17th INTER-NOISE conference which was held in Avignon, France in 1988. In 1990, the new series of French Congresses on Acoustics was launched in Lyon. The second Congress was held in Archchon in 1992, and the next will be in Toulouse in 1994. For more information on the French Acoustical Society, contact the Secrétariat de la SFA, 33 rue Croulebarbe, 75013 PARIS, France. Telephone: +33 1 45 35 54 00; FAX: +33 1 43 31 74 26.

This is the first in a series of articles on the history and activities of the Member Societies of International INCE. - Ed.

People

Maglieri Wins Aerospace Award

Domenic J. Maglieri, a member of INCE/USA, has been selected by the American Institute of Aeronautics and Astronautics (AIAA) to receive its Engineer of the Year award for 1993. This award is presented to an individual member of the AIAA who has distinguished himself/herself in some facet of aerospace engineering. He was cited "For outstanding contributions to the fundamental understanding, prediction, and control of aircraft noise and sonic booms; therefore, furthering the design of environmentally acceptable commercial aircraft systems." The award was presented on 1993 February 17 during the AIAA Aerospace Design Conference in Irvine, California, USA.

Maglieri is Director of Projects for the Hampton Division of Eagle Engineering, Inc., and has served in this capacity since retiring from the NASA Langley Research center. For 35 years at NASA Langley, he was a leader in research and management in the areas of aircraft noise and sonic boom effects. He has authored or coauthored more than 150 technical papers on gust loads, airplane and helicopter noise, sonic boom, and subsonic and supersonic transport technology. Since the late 1950s, he has been a leader in the planning, implementation, and acquisition of sonic boom data on all of the supersonic aircraft and spacecraft vehicles, and in the prediction of sonic boom effects for the next generation of high speed aircraft and aerospace planes. He is internationally recognized for his work.

Maglieri was the leader of the Eagle Engineering effort in support of the Nordham Company of Tulsa, Oklahoma, USA, in the development of hush kits for the Pratt & Whitney engine on the Boeing 737 aircraft, and he has played a major role in the attainment of the noise requirements of the Federal Aviation Administration (FAA).

With nearly 40,000 members, the AIAA is the largest and oldest American technical society devoted to the progress of science and engineering in aviation and space.

Dr. Eric E. Ungar Affiliates with Acentech

Acentech Incorporated has announced that Dr. Eric E. Ungar, will work for the company in a part-time capacity as Chief Engineering Scientist. He continues his primary employment as Chief Consulting Engineer for Bolt Beranek and Newman, Inc. (BBN), where he has worked since 1958. Dr. Ungar served as President of INCE/USA in 1985, and was a member of the INCE/USA Board of Directors from 1980 to 1982 and from 1985 to 1987.

At Acentech, Dr. Ungar will be responsible for bringing his technical expertise to bear on a wide variety of vibration and noise problems, particularly relating to buildings and industrial facilities and equipment. At BBN, he will continue to work on federally funded research and development programs and the solution of problems in the fields of marine systems and active vibration control.

Over the past two decades, Dr. Ungar has worked on several leading-edge projects concerned with facilities that accommodate highly vibration-sensitive equipment or that require high resistance to vibration-induced damage or malfunction.

With more than 40 years of engineering research and consulting experience in acoustical technology, Dr. Ungar has received numerous honors. He recently served as President of the Acoustical Society of America. Additional honors and professional society affiliations include Fellow, Acoustical Society of America; Life Fellow, American Society of Mechanical Engineers; Member and past President of the Institute of Noise Control Engineering; and Associate Fellow, American Institute of Aeronautics and Astronautics.

Dr. Ungar has written and contributed to numerous books, papers and technical reports. His papers have appeared in the *Journal of the Acoustical Society of America, Sound and Vibration*, and several ASME journals. A 1951 graduate of Washington University, Dr. Ungar received his M.S. at the University of New Mexico (1954), and his Eng. Sc.D. at New York University (1957).

Acentech Incorporated, with offices in Cambridge, Mass., and Los Angeles, is a consulting firm specializing in noise and vibration control; industrial and environmental acoustics; architectural acoustics; and sound system, audio-visual, and video system design. Originally a subsidiary of BBN, senior management purchased a majority interest in the firm in 1991.

RH Lyon Corp. is Awarded Nissan Contract

RH Lyon Corp, a Massachusetts, USA engineering firm, has been awarded a contract by the Vehicle Research Laboratory of the Nissan Motor Company Ltd. of Yokosuka, Japan, to apply noise and vibration reduction techniques to future models of the Infiniti G20 automobile.

RH Lyon Corp will employ new methods of noise and vibration analysis developed by its president, Dr. Richard Lyon, a Member of INCE/USA and Professor of Mechanical Engineering at Massachusetts Institute of Technology, to determine how Nissan can reduce suspension-borne road noise to make the interior of the Infiniti G20 quieter.

Founded in 1976 by Dr. Richard Lyon, RH Lyon Corp is an engineering firm specializing in quiet product design and advanced vibration diagnostic system development for leading manufacturers throughout the world. RH Lyon Corp has completed numerous projects for clients in the transportation industry, including General Motors, Ford, and Bosch.

ISU Engineering Professor Receives Mentorship Award

Iowa State University's Women in Science and Engineering program established an Anna L. Pate Award for mentorship. The group presented Pate with the first award at a luncheon recently. She is a professor of engineering mechanics at ISU's College of Engineering.

The award was created to honor Pate's dedication to inspiring women and minorities to enter and remain in engineering programs at ISU and for her success in motivating other engineering professors to foster a mentoring attitude toward women and minority students.

During the luncheon ceremony, David Holger, chair of ISU's aerospace engineering and engineering mechanics department congratulated Pate for her significant accomplishments as a faculty member, researcher, teacher and colleague and presented her with a check for USD 250.

Pate has received more than USD 2 million in research grants while at ISU. Her research topics range from acoustics to research careers for minorities. She has authored and co-authored over 30 publications and holds a patent for a sound intensity measuring method.

Pate, who is originally from Radom, Poland, received her B.S. and M.S. degrees in electrical engineering from the Technical University of Warsaw and her Ph.D. in mechanical engineering from the Technical University of Krakow, Poland.

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Feature

Design and Performance of a Hemi-Anechoic Room for Measurement of the Noise Emitted by Computer and Business Equipment

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IBM Acoustics Laboratory, Poughkeepsie, NY 12602, USA

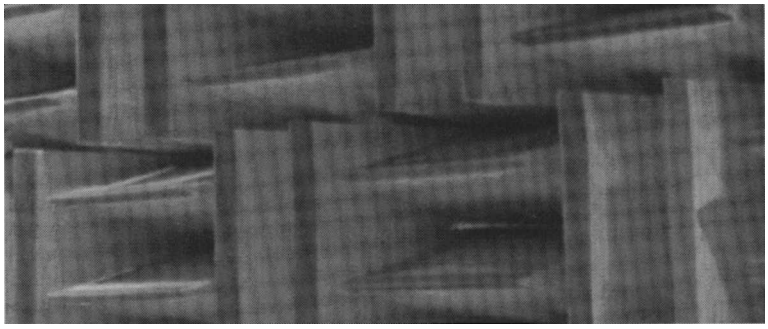
Introduction

The primary purpose of this paper is to describe a large hemi-anechoic room which was specially constructed for measuring the noise emissions of computer and business equipment. The need for such measurements became evident with the advent of large-scale computers in the 1950s. In order to design a quiet product, the manufacturer must have the resources to make an adequate assessment of its noise emissions. The first noise emission measurements on computers and business equipment were made by IBM Poughkeepsie in the mid-1950s, initially in a converted two-car garage and later in a building that was non-magnetic, but otherwise had no special acoustical properties. A facility for product noise measurements was clearly required.

The planning for IBM Poughkeepsie's first acoustics laboratory began in 1960, and the building was completed in 1961. At the time the facility was designed, there were no standards for noise emission measurements on computers and business equipment. Indeed, no industry had its own standards for noise measurements. There were no guidelines for the design of an acoustical facility. All that was available was an advance draft of what was subsequently published as ANSI S1.2-1962, American National Standard for the Physical Measurement of Sound [1]. While the draft provided little guidance on the design of a laboratory facility, it did include some important warnings:

Since equipment for the direct measurement of acoustic intensity is not available at this time, this standard presents several methods for computing the sound power from sound pressure level measurements... This (measurement) method is at present not recommended for the determination of the sound power of sources emitting line spectra or spectra of narrow bandwidth.... These sounds must be nonimpulsive....

In view of the absence of industry standards and guidelines for the design and construction of an acoustics facility, it was decided that the laboratory should provide all three environments for which measurement methods were prescribed by ANSI



S1.2-1962, namely a free field, a free field above a reflecting plane and a diffuse field. The acoustics laboratory was constructed as a stand-alone building on a quiet suburban site so that single-shell construction could be used throughout. It consisted of a reverberation room, an anechoic room (convertible into a hemi-anechoic room by removal of the floor wedges), and a project-control room. The features of the acoustical test rooms are summarized in Appendix A. The reverberation room is still in use today for the type of measurements for which it was originally designed, i.e., rapid determinations of the sound power levels of devices, components, and subassemblies, which are the constituent noise-generating parts within the external frame of a computer unit.

The free-field chamber of the original facility was one of the few rooms in the world that could be converted from a totally free field to a free field over

a reflecting plane; this was accomplished by by removing the wedge units which covered the floor in order to expose a concrete surface. It was not known at the time of the design (1960) if the industry standard test would ultimately require a completely free field or a free field over a reflecting plane. In the convertible room, individual computer units with volumes up to 2 cubic meters and weighing up to a ton could be rolled across the concrete floor to a hydraulic lift which could be used to move the the machine under test to the center of the room. The floor wedges would then be replaced to create a completely free field. The ceiling of the room was high enough so that a microphone array could be installed around the machine to sample the sound pressure field. It was quickly found that installing and operating a computer unit on the top of a hydraulic lift was a time-consuming procedure.

By the mid-1960s, it became clear that the computer industry would ultimately standardize a hemi-anechoic environment for measurements of the noise emissions of its products. The rationale at the time was that most computers operate over a hard floor, but other acoustical characteristics of a computer room vary greatly; some have absorptive ceilings and walls, others do not. By specifying a hemi-anechoic environment, one makes measurements over a hard floor in the absence of reflections from walls and ceilng. After 1970, all noise emission measurements in the industry were made with the machine under test standing on a rigid floor.

At the beginning of the decade of the 1980s, it was recognized that the intensive standards development activity then in progress would influence the kind of acoustical facilities that would be required in the future. A careful examination was made of the facilities provided by the IBM Acoustics Laboratory, Poughkeepsie, for making noise emission measurements on computer equipment, particularly large processors. It was concluded that the reverberation room continued to be satisfactory for the rapid determination of the acoustic power output of devices, components and subassemblies. But the hemi-anechoic room was obsolete and could no longer be used for its original purpose, i.e., for sound pressure level measurements from which the sound power levels of large processors could be determined.

Over a span of two decades, the dimensions of the central processors of large-scale computer systems had increased to the point that it was difficult to fit them into the existing hemi-anechoic room. The height of the room had been originally selected to accommodate a microphone array for measurements of a machine under test in a completely free field operating at the top of a hydraulic lift. What was needed to accommodate the large processors was more length and width and a lower room height. As their physical sizes became larger, the power requirements of the processors increased beyond the electrical capacity of the room. Moreover, the original hemi-anechoic room did not have provision for a supply of chilled water— which became necessary when water-cooled processors had to be evaluated under a full electrical load. The original hemi-anechoic room had no provision for a computer-room raised floor with removable tiles under which signal, power, and chilled-water lines could be installed. For these reasons, it became necessary to design and construct a new hemi-anechoic facility for the measurement of the noise emissions of computer equipment of all sizes up to and including the senior processors of the IBM product line.

Noise Emission Measurement Standards

Early in 1970, a newly-formed working group (WG 6) of Technical Committee 43 ("Acoustics"), Subcommittee 1 ("Noise") of the International Organization for Standardization (ISO) met in Zürich, Switzerland to begin work on a new series of International Standards for measuring the noise emissions of machines. During the decade of the 1970s, Working Group 6 developed the ISO 3740-series of basic standards [2-8] which established the sound power level of a stationary source as the primary descriptor of its noise emission. In 1975, the Computer and Business Equipment Manufacturers Association (CBEMA) formed a product acoustics subcommittee which was tasked to prepare an acoustical test code for computers that was to be based on the ISO 3740-series standards. This test code was published by the American National Standards Institute as ANSI S1.29-1979 [9], the first standard specifically applicable to noise emission measurements on computers and business equipment.

Subsequently, CBEMA's European counterpart, the European Computer Manufacturers Association (ECMA), extended ANSI S1.29-1979 by expanding the information provided on the installation and operating conditions to be used in the evaluation of the different classes of computer and business equipment. This resulted in the publication of ECMA-74 in 1981 [10]. ECMA-74 then became the basis for the revision by CBEMA of ANSI S1.29-1979; the revision was published as ANSI S12.10-1985 [11]. To complete the cycle, ECMA subsequently published a revision of ECMA-74 in 1987 [12]. Throughout this standards development effort, the two trade associations, CBEMA and ECMA, worked closely together to produce an acoustical test code that would have industry-wide and worldwide validity.

On the international level, ANSI S1.29-1979 became the basis for a Draft International Standard which was prepared in 1980, but was not published until 1988 as ISO 7779 [13]. This International Standard is currently being updated to reflect the changes that are in progress with the revision of the ISO 3740-series and the updating of the latest version of ECMA-74. All of the standards development activity summarized above, which took place during the decades of the 1970s and 1980s, prescribed methods for determining the sound power levels of noise sources from measurements of sound pressure levels.

Before it was disbanded, ISO Working Group 6 recognized that for some purposes it could also be important for sound pressure level measurements to be made, not for determinations of sound power levels, but for characterizing the noise at the operator's or bystander's position(s). Guidelines for the preparation of test codes which require noise measurements at these positions were published as ISO 6081 in 1986 [14]. At the time of publication, there was very little interest in such guidelines. In 1989, however, the European Community published a directive [15] which requires that emission sound pressure level measurements be made at the operator's and at other specified positions. To satisfy the requirements of the EC Directive, which are intended to control the levels of noise at work stations, a new ISO working group (WG 28) was established to revise ISO 6081. A new series of five International Standards (the ISO 11200-series) dealing with emission sound pressure levels at the operator's position and at other specified positions in the vicinity of a machine has been completed and will soon be circulated by the ISO Central Secretariat as Draft International Standards.

The Design of a New Hemi-Anechoic Room

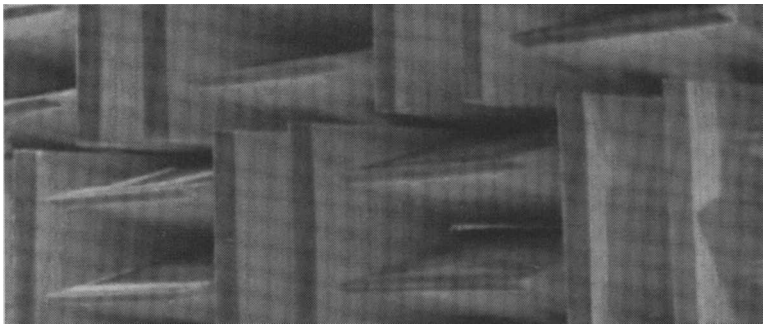
In this paper, we describe the new hemi-anechoic room constructed specifically for the measurement of the noise emission of computer equipment according to the standards described above. The important parameters in the design of the facility are identified, and the implementation of several requirements is described. A test facility for measuring the absorption coefficient of the glass fiber wedges used in the room was adapted for use with the two-microphone method now standardized by the American Society for Testing and Materials (ASTM) [16], A sample of the wedges installed in the room was tested to determine the so-called cutoff frequency, the highest frequency below which the *pressure* reflection coefficient exceeds 0.10. Both the conventional standing wave tube method [17] and the new two-microphone method were used for evaluation of the wedges. The characteristics of the room are summarized in Appendix B.

The performance of the completed room was evaluated by two methods. The room was first evaluated using the draw-away procedures that are specified in ISO 3745 [7] to determine the free-field volume of the room; then the *absolute comparison method* of ISO 3744 [6] was used; the sound power output of a standard reference sound source (RSS) was determined and compared with the values supplied by the manufacturer.

Test Facility Requirements

Work began in 1982 on the design of the new hemi-anechoic room and a supporting laboratory area (control room) for the Poughkeepsie Acoustics Laboratory. Although the construction of the new facility was completed in 1985, it took several years before the acoustical evaluations of its performance were completed, and the facility was fully accredited. This paper describes in some detail the design and evaluation of the facility from start to completion. Several key items were addressed early in the design stage:

1. Size. The dimensions inside the wedges had to



be large enough to make noise emission measurements on typical large processor configurations according to the requirements of ISO 3744.

2. Single-shell construction. The floor area of the facility, the weight of the equipment to be tested and the cost of the overall facility made it essential to construct the facility as a single shell, without vibration isolation from the ground.

3. Raised Floor. The floor of the facility had to be raised to accommodate under-floor cabling and water hoses between the processor under test and support equipment located outside the hemi-anechoic room.

4. Air Conditioning. The air-conditioning system for the room had to be large enough to maintain a temperature of 23 degrees C in the room during the testing of a typical large processor.

5. Chilled water. Modern large processors are partially water-cooled. Because power supply noise

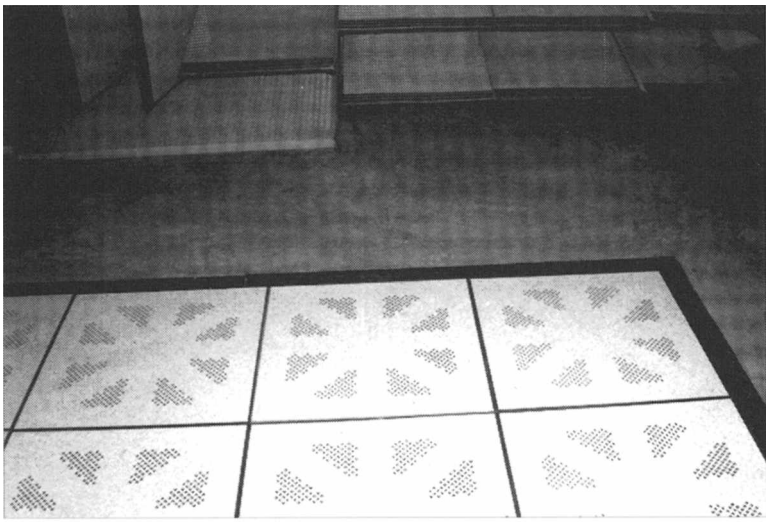


Fig. 1. A view of the raised floor showing perforated floor panels.

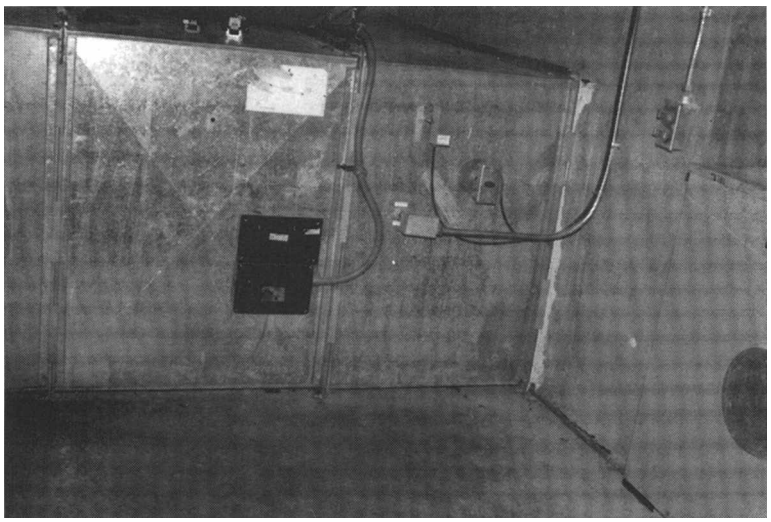


Fig. 2. Rectangular supply duct from the air-conditioning system to the hemi-anechoic room.

frequently varies with load, it is usually necessary to test the machines under full power. Therefore, it was a requirement that chilled water be available in the new facility. As an example, an IBM ES/9000 Model 580 processor requires a water flow rate of 180 liters per minute, and approximately 38 kW of the machine's heat load is removed by chilled water.

6. Electrical requirements. An adequate mix of electrical power must be provided both inside and outside the hemi-anechoic room. When a large processor is under test, its support equipment is located outside the hemi-anechoic room. If the support equipment is also scheduled for test, adequate electrical power for it must exist inside the hemi-anechoic room. As an example, an IBM ES/9000, Model 580 has an electrical load of approximately 58 kVA.

7. Background noise. The background noise level in the room with the air conditioning system operating should be 10 dB below the lowest levels of equipment under test.

8. Wedge cutoff frequency. The cutoff frequency of the wedges in the room was required to be low enough to make accurate measurements of the equipment noise emissions in the 125 Hz octave band.

Test Facility Design

1. Size. After careful consideration of the test requirements, the dimensions of the room inside the wedges were selected to be 10.56 m by 7.22 m by 3.84 m in height. The resulting space permits the taking of noise level data on a 1-m measurement surface around a typical large processor— to meet the requirements of ISO 3744.

2. Single-shell construction. As with the original anechoic chamber constructed during 1961, this facility was designed as a single-shell room. The acoustics laboratory and this additional facility are located in a relatively remote and quiet part of the Poughkeepsie site. Care was taken to minimize transmission of ground-conducted vibration into the facility; it was found to be necessary to remove a rock ledge that was discovered during excavation. The under-foundation fill consists of a uniformly graded mixture of sand and gravel having no stone greater than 75 mm in any dimension. The compacted fill has a minimum depth of 150 mm.

The floor slab is 152 mm thick concrete. The walls of the hemi-anechoic room are constructed of 305-mm thick, steel-reinforced concrete. The roof consists of 305-mm thick precast Flexicore sections covered with 50 mm of concrete and an 18-mm thick rigid insulation with a gravel topping.

3. Raised floor. The 8.5 m by 5.5 m raised floor in the hemi-anechoic room was achieved by installing 610 mm x 610 mm raised floor panels over a 450-mm deep pit. The surface formed by the raised floor tiles is at the same elevation as the concrete floor, making it easy to roll machines in and out of the hemi-anechoic room. There is a concrete strip approximately 1 m wide between the edges of the raised floor and the tips of the wedges.

The raised floor panels are typical of those used in large data processing installations. Most of the panels along the periphery of the raised floor are perforated since the room air inlet ducts are located under the raised floor. Some of the perforated floor panels are visible in Fig. 1.

4. Air Conditioning. The air-conditioning system is a forced air dual-speed unit. A single large blower provides air for both the hemi-anechoic room and the adjacent control room. At the higher speed (820 rpm), the centrifugal blower provides approximately 8500 cubic meters of air per hour to the hemi-

anechoic room. The air flow decreases to approximately 4250 cubic meters per hour when the blower is operated at low speed (410 rpm). Speed selection is manually controlled. At the higher speed, the unit can provide 99 kW of air conditioning; 55 kW for the hemi-anechoic room and 44 kW for the control room.

The air-conditioning system is located in a separate room with a vibration break between its floor slab and the rest of the building. The system is mounted on steel spring vibration isolators, and there are canvas vibration breaks between the air-conditioning unit and the air ducts to and from the hemi-anechoic room and the control room.

The supply duct to the hemi-anechoic room starts (at the air-conditioning unit) with a 1.7 m by 0.76 m by 6 m long rectangular duct with one 90-degree bend. Part of the rectangular duct can be seen in Fig. 2.

The air supply path continues through a 20.7 m long, 1-m diameter duct with four 90-degree bends. The ducts described above are lined with 50-mm thick fiberglass. The remainder of the supply ducts (described below) are lined with 25-mm thick fiberglass. At this juncture, the supply duct splits into two paths, one along each long side of the pit under the raised floor. Each path consists of a 9.5-m long, 0.76-m diameter duct with one 90-degree bend and terminates with a 3-m long, 0.5-m diameter duct.

There are four air supply branches at each side under the raised floor. Each supply branch consist of an approximately 0.6 m by 0.3 m by 0.6-m long rectangular duct lined with 25-mm thick fiberglass. Two of the supply branches at each side extend from the 0.76 m diameter duct and the other two extend from the 0.5 m diameter terminating duct.

Each rectangular branch was originally terminated with a manually-adjustable multi-louvered damper. However, the background noise level in the hemi-anechoic room was affected by the dampers, and they were removed prior to the facility becoming operational. A photograph of one of the air supply branches (with the damper removed) is shown in Fig. 3.

The return air path starts toward the top of one side of the hemi-anechoic room with the openings of four rectangular ducts. Three of the four ducts are shown in Fig. 4. Each duct is 0.6 m square and 1.8 m long and is lined with 25-mm thick fiberglass. The four ducts terminate in a 1.5 m by 1.0 m by 6.4-m long plenum lined with 50-mm thick fiberglass.

The return air proceeds from the plenum through a 21-m long, 1-m diameter duct with three 90 degree bends. The 1-m diameter duct is lined with 50-mm thick fiberglass. A portion of the 1-m diameter duct can be seen in Fig. 5.

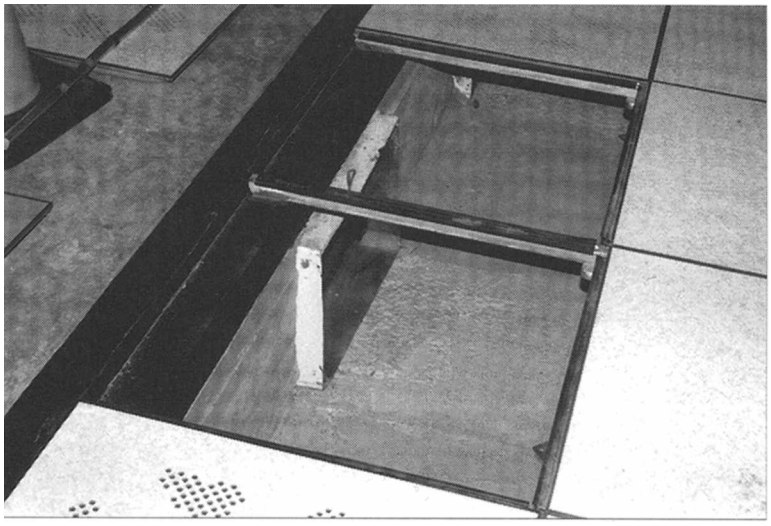


Fig. 3. Air supply into the hemi-anechoic room from under the raised floor.

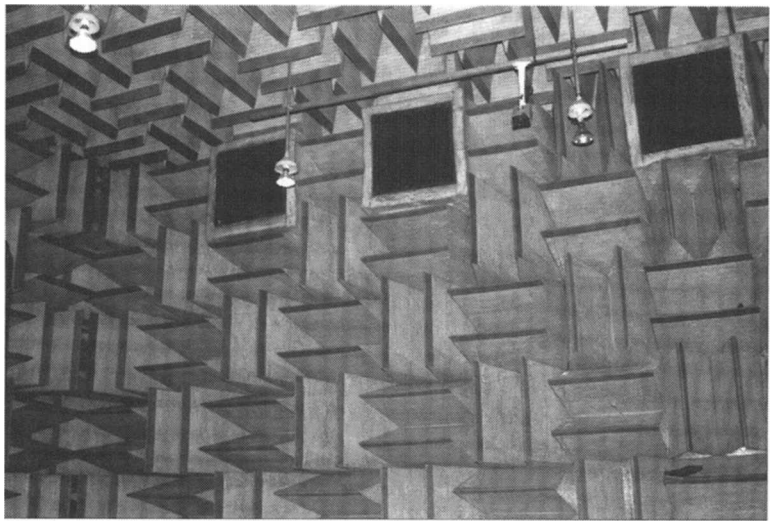


Fig. 4. A view of the anechoic wedges showing three of the four return ducts from the hemi-anechoic room.

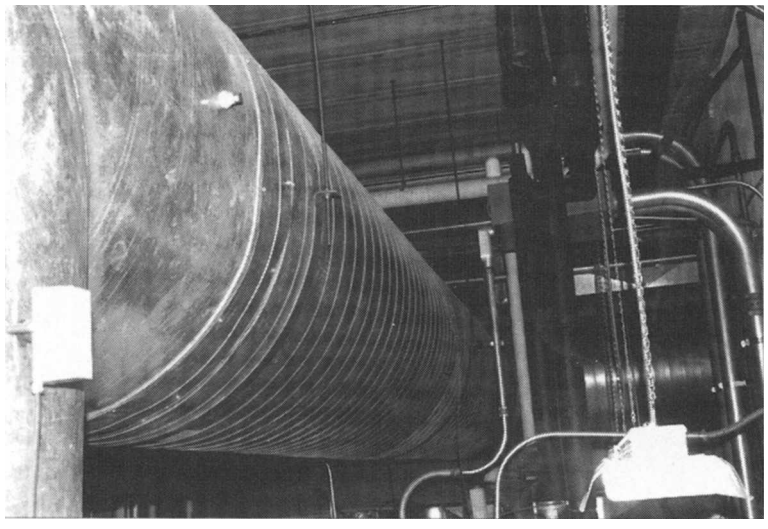


Fig. 5. Circular air return duct as it enters the air-conditioning system.

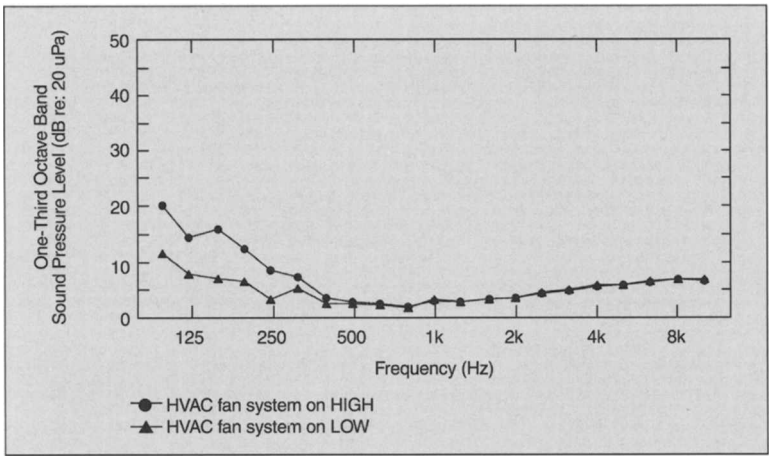


Fig. 6. Background noise level in the hemi-anechoic room— with air system on high speed and with air system on low speed.

The air supply and return ducts for the control room are separate from those for the hemi-anechoic room; this ducting is not as complex since the background noise level in the control room is not critical. At the higher blower speed, the system provides approximately 6800 cubic meters of air per hour to the control room.

Considerable effort was expended in designing the air-conditioning system for low background noise levels in the hemi-anechoic room. The design originally proposed by the architect was acoustically unsatisfactory. A large relatively noisy air-handling unit was to be located much too close to the hemi-anechoic room with very short duct runs and only one or two bends. Calculations using the empirical methods of the ASHRAE Handbook [18] showed that the expectedbackground noise levels which resulting from this design to be completely unacceptable. The authors were enlisted to work with the architect and the IBM Facilities Engineers to accomplish an acceptable design, again relying on the ASHRAE methods and their predictions of duct attenuations.

5. Chilled water. The amount of chilled water required to cool a typical large processor is dependent upon the temperature of the water and the flow rate. No problem has been encountered in meeting this requirement since the site is serviced by a central facility that provides adequate chilled water. Chilled water outlets are located both outside the hemi-anechoic room and in a pit under the raised floor. The pit is equipped with an emergency dual sump pump system to evacuate water.

6. Electrical requirements. Two 150 A and one 30 A, 60-Hz receptacles were installed outside the hemi-anechoic room. The 150 A receptacles provide power for the processor being evaluated, and the 30 A receptacle provides power for operating air-moving devices and chilled water pumps. Similar receptacles are also located under the raised floor in the hemi-anechoic room.

A 60-Hz bus duct was installed under the raised floor to provide flexibility for testing various products. A wide variety of outlet boxes can easily be installed on the bus duct; each box on the duct is equipped with a suitable circuit breaker. A second bus duct under the raised floor provides either 50-Hz or 400-Hz power from small motor generator sets located in a remote utility room.

7. Background Noise. One-third octave band noise levels in the new hemi-anechoic room are shown in Fig. 6. These levels are relatively low for single-shell construction without a spring-mounted floating floor. Data are shown for the air-handling system on high speed and for the system on low speed. The background noise level in the hemi-anechoic room with the air system on low speed is essentially equal to that measured with the system turned off. The low background noise levels allow the facility to be used to test a wide range of products, including machines which may contain only a single cooling fan and small components such as hard files, motors, and power supplies.

Acoustical Evaluation

Evaluation of the Anechoic Wedges

The wedges were designed, built and installed by Eckel Industries Inc. of Cambridge, Massachusetts, USA. The absorptive material is a lightweight fiberglass. Each dual-tip wedge module is mounted on a 0.61-m square metal base with a 35-mm air gap between the base of the module and the fiberglass material. The wedges measures 160 mm from the bottom of the fiberglass to the start of the taper and 710 mm from the start of the taper to the tip of the wedge. The overall depth of a wedge module from tip to base is 905 mm. The fiberglass is covered with

Table 1. Normal incidence absorption coefficient at 90 Hz for ten wedges evaluated in an impedance tube. The average absorption coefficient is 0.992.

Wedge Number	Absorption Coefficient
1	0.992
2	0.992
3	0.992
4	0.983
5	0.996
6	0.992
7	0.992
8	0.997
9	0.993
10	0.992

Table 2. The low-frequency cutoff of each wedge listed in Table 1.

Wedge Number	Low-Frequency Cutoff (Hz)
1	85
2	85
3	86
4	96
5	85
6	85
7	85
8	85
9	86
10	85

a fine mesh, galvanized hardware cloth to minimize damage to the wedges.

Samples of the wedge modules were evaluated in a 0.6 m square, 4.25 m long impedance tube constructed in the IBM Acoustics Laboratory. The normal incidence sound absorption coefficients of the samples were determined using both the ASTM single-frequency standing wave ratio method [17] and the ASTM two-microphone method [16]. Detailed results of these evaluations have been published elsewhere [19].

The measured normal incidence sound absorption coefficients at a frequency of 90 Hz are listed in Table 1 for a sample of 10 wedges. The average absorption coefficient is 0.992; the wedges met their absorption coefficient specification (at least 0.99 at 90 Hz) and were considered satisfactory for use in the hemi-anechoic room. The low-frequency cutoff of each wedge is listed in Table 2.

In-Situ Evaluation of the Lining of the Room

The objectives summarized above were met by the design of the facility. However, the free-field characteristics of the room are the most important for measurement of the noise emissions of machines. Two key methods were used to evaluate the performance of the room, the draw-away procedure specified in ISO 3745 and the *absolute comparison test* specified in ISO 3744. In addition, some experiments with the *carousel method* described by Moreland [20] were attempted, but the results are not reported here. The *carousel method* is similar to evaluation methods reported by Kutruff and Bruchmuller [21] and Davy [22]. The intensity method for the evaluation of hemi-anechoic rooms proposed by Nelson [23] was not attempted, but could be useful in future evaluations.

The design of the sound source used for the draw-away tests was found to be critical. In ISO 3745, three sources are described which are to be used for different frequency bands covering the frequency range of interest. The directivity of these sources is also specified. It was found that the desired directivity characteristics could not be met when these sources were placed on the floor of the hemi-anechoic room; the sources described in ISO 3745 are more appropriate for use in a fully-anechoic room.

A new source, shown in Fig. 7, was designed for use in evaluating the hemi-anechoic room. It has a height of 90 mm and horizontal dimensions of 568 mm by 568 mm. A small 100-mm diameter loudspeaker is mounted at a height of 80 mm inside the box, and a steel plate with a 12-mm diameter hole in the center is spaced 10 mm above the loudspeaker. The steel base, loudspeaker mounting plate, and top plate are covered on both sides with damping material. The directivity characteristics of this source are superior to the characteristics of the sources specified in [7] when the source is placed on the floor of

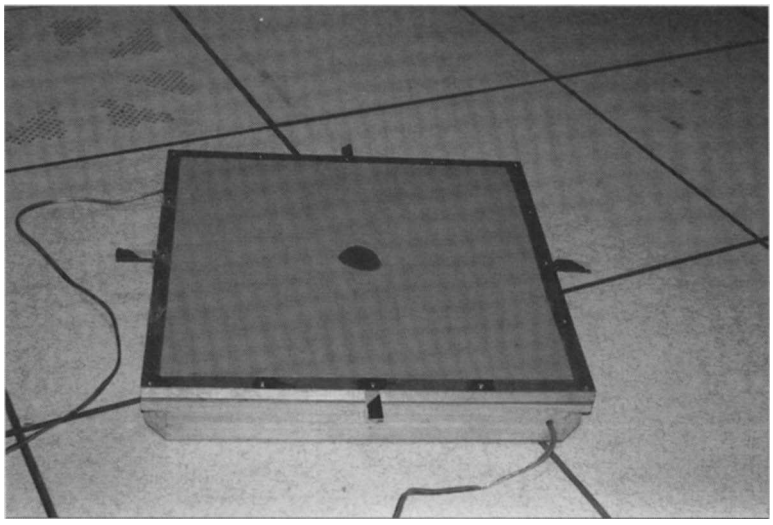


Fig. 7. Flat test source for draw-away experiments. The source was designed to be used on top of the raised floor or to replace a floor panel so that the source is in the plane of the floor.

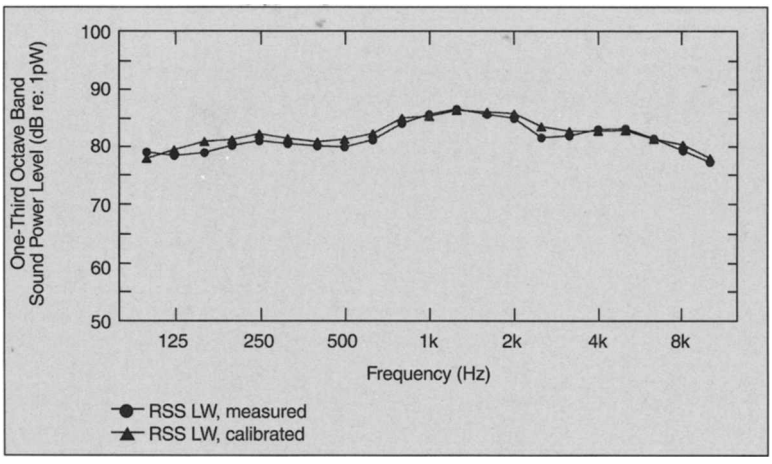


Fig. 8. Comparison of the measured value of the Reference Sound Source (RSS) with the calibrated value given by the manufacturer

the hemi-anechoic room, and are even better when the source is placed in the plane of the floor. Moreover, a single source can be used over the entire frequency range of interest, thus reducing measurement time. An alternative sound source has been proposed by Yeager [24], but this source was not used in the evaluations reported here.

Since reference [7] specifies that the draw-away evaluations may be performed with broadband noise rather than discrete-frequency tones, the loudspeaker was driven with pink noise, and the draw-away evaluations were done in one-third octave bands.

The directivity characteristics of the source and the detailed results of the draw-away testing have been published elsewhere [25-26]. A sample of the results of a draw-away test are shown in Tables 3 and 4. Table 5 gives the ISO 3745 requirements on the deviation of the measured level from the level for inverse square spreading. The draw-away tests conducted to evaluate the hemi-anechoic room showed that these requirements were met.

For the absolute comparison test of ISO 3744, the sound power level of a calibrated reference sound source (RSS) is measured in the room and compared with the calibrated value. A Brüel & Kjær Type 4204 reference sound source was evaluated in the hemi-anechoic room using a 20-position microphone array. The results, given in Fig. 8, show that the measured levels are very close to the values obtained by the manufacturer of the RSS. ISO 3744 states that the sound power level measured in a qualified facility should be within 2 dB of the calibrated value of the sound power level supplied by the manufacturer. This requirement is met in the new hemi-anechoic room.

Conclusions

The new hemi-anechoic room in the IBM

Table 3. Draw-away data for the source in the plane of the floor. The values in the table are one-third octave band sound pressure levels. The levels have been corrected for inverse square spreading. D is the distance from the source to the microphone in meters.

	ONE-THIRD OCTAVE BAND CENTER FREQUENCY IN HZ									
D	100	125	160	200	250	315	400	500	630	800
0.5	63.2	65.2	68.7	69.0	61.5	62.0	62.0	58.2	55.5	54.5
1.0	63.0	65.3	69.0	68.8	61.8	62.3	62.3	58.8	55.5	53.5
1.5	63.8	65.3	68.8	69.3	61.8	62.0	62.3	59.0	55.8	53.5
2.0	62.8	65.3	67.8	68.8	61.5	61.8	62.3	58.5	55.8	53.8
2.5	62.5	66.0	67.7	69.2	62.0	61.5	62.2	58.7	56.2	53.7
3.0	62.8	66.0	69.0	68.3	61.5	62.3	62.3	58.8	56.0	53.8
3.5	63.9	65.1	69.6	68.4	61.4	61.9	62.6	58.9	56.1	53.9
4.0	64.5	65.0	69.0	69.5	61.0	61.8	62.8	58.8	56.0	53.8
4.5	64.3	65.6	68.6	69.3	61.6	61.6	62.3	59.1	55.8	53.8
5.0	64.0	66.5	69.2	69.0	62.0	61.5	62.0	59.2	55.7	53.7
5.5	63.8	67.1	70.1	69.3	61.6	61.3	62.1	59.3	56.1	53.8
6.0	63.1	66.6	71.1	70.3	61.8	61.8	61.6	59.1	56.6	53.6
6.5	62.3	65.8	70.8	71.5	63.0	62.0	61.8	58.5	56.0	54.3
7.0	61.2	64.7	68.9	69.9	63.9	62.9	62.9	58.7	57.2	53.7

	ONE-THIRD OCTAVE BAND CENTER FREQUENCY IN HZ										
D	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000
0.5	52.5	51.7	51.2	48.7	51.0	50.5	48.7	49.5	58.0	55.7	48.2
1.0	52.0	51.5	51.5	49.0	51.0	50.5	48.5	49.0	58.3	56.0	47.3
1.5	51.8	51.3	51.5	48.5	50.8	50.5	48.8	49.3	57.3	55.3	48.0
2.0	51.8	51.3	51.5	48.3	50.8	50.3	48.5	49.3	57.3	54.8	47.3
2.5	52.0	51.2	51.7	48.5	51.0	50.2	48.5	49.5	58.0	54.7	46.5
3.0	51.8	51.3	51.5	48.3	50.8	50.3	48.3	49.8	57.5	55.0	46.8
3.5	51.9	51.4	51.6	48.1	50.9	50.4	48.4	49.6	57.9	54.9	46.6
4.0	51.8	51.3	51.8	48.3	51.0	50.3	48.5	49.5	57.8	54.8	46.8
4.5	51.8	51.6	51.8	48.3	50.8	50.3	48.6	49.6	58.1	54.8	46.8
5.0	51.7	51.5	51.7	48.5	50.7	50.2	48.7	49.5	58.0	54.7	46.7
5.5	51.8	51.6	51.8	48.6	50.8	50.3	48.6	49.6	57.8	54.6	46.8
6.0	51.8	51.3	51.8	48.6	51.1	50.3	48.6	49.3	57.8	54.8	46.8
6.5	51.5	51.5	51.8	48.5	51.0	50.3	48.8	49.3	57.8	54.8	46.5
7.0	51.4	51.7	51.9	48.4	51.2	50.2	48.7	49.2	57.7	54.7	46.7

Table 4. Draw-away data for the source on the floor. The values in the table are one-third octave band sound pressure levels. The levels have been corrected for inverse square spreading. D is the distance from the source to the microphone in meters.

D	100	125	160	200	250	315	400	500	630	800
0.5	62.5	65.2	67.2	68.0	60.2	61.0	61.0	56.7	54.0	56.5
1.0	62.3	66.0	67.8	68.0	61.0	61.8	61.8	57.0	50.5	52.8
1.5	62.3	65.5	67.8	69.0	61.0	62.0	62.3	57.8	50.5	50.3
2.0	62.0	65.5	67.8	68.8	61.3	61.8	62.8	58.3	50.8	49.5
2.5	62.5	67.2	67.2	68.7	62.0	61.7	63.2	58.5	51.2	49.0
3.0	62.0	67.3	68.5	67.3	61.5	62.8	63.8	58.8	52.0	48.0
3.5	62.6	66.6	69.9	67.6	61.1	62.6	63.4	58.6	52.1	48.4
4.0	63.3	66.0	69.5	69.0	61.0	62.3	63.8	58.8	52.5	48.5
4.5	63.6	65.8	68.3	69.3	61.6	61.6	63.6	59.3	52.3	49.3
5.0	63.7	66.7	69.0	68.7	61.7	61.7	63.2	59.2	52.2	48.2
5.5	63.6	67.1	69.3	68.8	62.1	62.1	63.3	59.3	52.3	48.3
6.0	62.8	67.3	70.8	69.8	62.1	61.8	62.6	59.1	52.3	48.3
6.5	63.0	66.8	70.3	70.8	63.0	62.3	62.5	58.5	52.3	49.3
7.0	62.9	66.2	68.7	69.7	63.9	63.4	63.7	58.2	53.2	48.9

D	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000
0.5	56.0	54.0	51.5	48.5	50.0	49.5	49.0	49.5	58.2	55.5	48.0
1.0	53.3	54.3	55.0	50.8	51.3	51.8	48.5	49.3	57.5	56.3	49.0
1.5	51.0	52.8	54.8	51.8	52.0	50.8	49.8	49.3	57.8	55.0	48.0
2.0	50.3	51.8	54.3	51.8	52.5	50.5	49.8	50.0	58.0	54.8	47.5
2.5	50.0	51.5	54.0	51.7	53.0	50.7	49.2	50.7	58.2	54.7	46.7
3.0	49.5	50.3	52.8	51.5	53.5	51.3	48.8	51.0	56.8	54.8	46.5
3.5	49.4	50.4	52.9	51.4	53.6	51.1	48.6	51.1	56.9	54.6	46.4
4.0	49.8	50.5	53.0	51.3	53.5	51.5	48.5	51.0	57.0	54.8	46.3
4.5	49.6	50.3	52.8	51.6	53.6	51.6	48.8	51.1	57.1	54.8	46.1
5.0	49.5	50.2	52.7	51.5	53.7	51.5	48.7	51.0	57.0	54.7	46.2
5.5	49.8	50.3	52.8	51.3	53.6	51.6	48.6	50.8	57.1	54.6	46.1
6.0	49.8	50.3	53.1	51.6	53.8	51.6	48.8	51.1	56.8	54.6	46.3
6.5	49.3	51.0	53.0	51.5	53.5	51.3	48.8	50.8	56.5	54.5	46.3
7.0	49.7	51.2	53.4	51.7	53.9	51.4	48.9	50.7	56.7	54.7	46.4

Poughkeepsie Acoustics Laboratory has been successfully used for the evaluation of the noise emissions of many products ranging in size from small disk drives used in personal computers to large mainframe processors.

The background noise levels have proved to be entirely satisfactory for the measurement of the noise emissions of these products. The wedges appear to perform satisfactorily, based on both an evaluation of a sample of individual wedges and the results of draw-away tests.

The air and chilled water systems have been used both for the testing of large processors and for the testing of coolant distribution units with few problems.

Accreditation

At the end of the decade of the 1980s, the National Institute of Standards and Technology, located in Gaithersburg, Maryland, USA, extended its National Voluntary Laboratory Accreditation Program (NVLAP) to include acoustical testing services. NVLAP accredits public and private testing laboratories by evaluating their technical qualifications and competence for conducting specific acoustical tests according to national and international standards. A laboratory's ability to meet established criteria and the technical requirements for the accreditation of specific acoustical test methods is determined by NVLAP through on-site assessments by technical experts. NVLAP accreditation indicates

Table 5. Maximum allowable differences between theoretical inverse-square spreading and measured levels for a hemi-anechoic room (from ISO 3745) [7].

One-third octave band center frequency	Allowable differencee (dB)
≤630	±2.5
800-5000	±2.0
≥6300	±3.0

that the laboratory's quality system, staff, facilities and equipment, calibration procedures, test methods and procedures, records, and test reports have been evaluated and found to meet NVLAP criteria [27]. In 1989, the accreditation process was initiated for the Poughkeepsie Acoustics Laboratory. In 1990, the initial NVLAP accreditation was received and the laboratory was reaccredited in 1992 for testing according to ISO 3741, ISO 3742, ISO 3744, ISO 3745 and ISO 7779.

According to the 1992 NVLAP directory, the Poughkeepsie Acoustics Laboratory is one of the two laboratories in the U.S.A. that is accredited for testing according to both ISO 7779 and ISO 3741.

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Appendix A. Characteristics of Original Laboratory Rooms

The reverberation room, used for the rapid determination of the sound power output of devices, components, subassemblies, and complete data processing machines, has the following characteristics:

Shape:	rectangular
Dimensions:	6.32 x 7.66 x 4.77 m^3
Volume:	230.9 m^3
Surface finish:	hard plaster covered with epoxy paint
Structure:	single shell on grade
Wall construction:	0.305 m concrete block; voids filled with concrete
Air-conditioning capacity:	17,525 W (ambient load)
Background noise level:	below the threshold of normal hearing
Frequency range of interest:	100 Hz to 10,000 Hz

The anechoic room, used for locating the principal noise sources, for determining their contributions to the total noise radiated by machines, and for obtaining directivity patterns of machines, has the following characteristics:

Convertibility:	convertible to a hemi-anechoic room with a hard floor
Shape:	rectangular
Dimensions of free field:	5.00 x 6.25 x 6.00 m^3
Dimensions of hemi-anechoic field:	5.00 x 6.25 x 6.96 m^3
Volume of free field:	187.5 m^3
Surface treatment:	fiberglass wedges (density: 64 kg/m^3) protected by wire cloth; total depth of treatment: 0.96 m
Structure:	single shell on grade
Wall construction:	0.305 m concrete blocks; voids filled with concrete
Open-mesh suspended floor:	formed by a grid of stainless steel aircraft cable each 2.4 mm diameter; suspended floor 2.27 m above concrete floor
Features:	hydraulic lift to raise machine under investigation through 2.1 m diameter hole in suspended cable floor and convertibility to hemi-anechoic environment
Air-conditioning capability:	17,525 W (ambient load)
Background noise level:	below threshold of normal hearing
Frequency range of interest:	100 Hz to 10,000 Hz
Wedge cutoff frequency:	90 Hz

Appendix B. Characteristics of New Hemi-Anechoic Room

The new hemi-anechoic room described in this paper, used primarily to determine the sound power levels of large data processing machines which require a rigid, raised floor for support and underfloor cabling, has the following characteristics:

Shape:	rectangular
Dimensions:	10.56 x 7.22 x 3.84 m^3 (measured from wedge tips)
Volume of free field:	292.8 m^3
Walls and ceiling:	fiberglass wedges 0.99 m deep, covered with galvanized wire mesh
Structure:	Single shell. The floor is 1.52-m concrete slab; the walls are 0.305-m steel-reinforced poured concrete; the roof consists of 0.305-m precast flexicore sections covered with 0.05-m poured concrete.
Floor:	8.5 x 5.5 m^2 raised floor (as typically found in a data processing center), consisting of 0.161 m^2 floor tiles elevated 0.45 m above a concrete subfloor
Air-conditioning system:	dual-speed forced air system, 99 kW capacity. High speed: 820 rpm, 2.36 m^3/sec. Low speed: 410 rpm, 1.18 m^3/sec
Background noise level:	below the threshold of hearing (air system on low speed)
Frequency range of interest:	100 Hz to 10,000 Hz
Wedge cutoff frequency:	90 Hz

The INTER-NOISE 93 Program

INTER-NOISE 93, the 1993 International Congress on Noise Control Engineering, will be held on the City Campus of Belgium's Katholieke Universiteit Leuven from the 24th to the 26th of August 1993.

INTER-NOISE 93 is the twenty-second in a series of annual international congresses on noise control engineering which have been held around the world since 1972. The Congress is sponsored by the International Institute of Noise Control Engineering, and is being jointly organized by the Belgian Acoustical Association ABAV and the Royal Flemish Society of Engineers K VIV.

The theme of the INTER-NOISE 93 is *People vs Noise*. Three plenary distinguished lectures on different aspects of noise control will be presented at INTER-NOISE 93. Prof. Eric Rathe, from the Eidgenoessische Technische Hochschule, Zürich, Switzerland, will present the keynote lecture on *People versus Noise*. Prof. Rathe summarizes his lecture as follows: Noise has become part of life, and it influences the overall quality of life very much. Each person's attitude to noise depends on many circumstances and individual habits. In spite of this difficulty we must keep assessing our present environmental situation and considering the aims and goals for the future.

Prof. Frank Fahy, from the University of Southampton, England, will present a distinguished lecture on "Statistical Energy Analysis: A Wolf in Sheep's Clothing?". The lecture will review the fundamental principles of SEA and discuss some of the more subtle traps for the unwary user. Statistical Energy Analysis is very attractive to the vibration analyst because, superficially, it appears to provide response estimates with a minimum of input data and computational power. The problem of confidence estimates will also be addressed.

Dr. Per Brüel, Brüel Acoustics and Brüel and Kjaer, Denmark, will present a distinguished lecture on "Induced Hearing Loss in Industry". This lecture will stress the importance of peak values when evaluating noise levels in workshops. It will be shown that high peak levels of very short duration can be very damaging for the hearing nerves.

More than 440 abstracts have been received from authors in 35 countries, and will be considered for presentation in 6 to 8 parallel sessions of invited and contributed papers related to different areas of noise control engineering.

The technical program will feature topics such as Acoustical and vibration measurements, Acoustical materials for noise control, Acoustical design of mufflers, Acoustic holography, Active noise and vibration control, Aircraft and airport noise, Analytical and numerical methods for noise control—FEM, BEM, SEA and Modal Analysis, Community Noise, CEN versus ISO standardization, Databases with noise control applications, EC1993 and noise control regulation, Environmental noise, Low frequency noise in dwellings, Machinery diagnostics using sound emission, Noise barriers and noise prediction methods, Noise control in buildings, Noise control in industry, Noise control in aviation, ships and vehicles, Propagation and damping of structural vibration, Sound intensity applications, Sound and vibration radiation and propagation, Sound propagation outdoors, Sound power determination, Signal processing and data acquisition systems for noise control engineering, Traffic and transportation noise control.

Special Technical Sessions have been organized by individuals and the organizing committee. The following Special Technical Sessions will be held within the normal technical program:

- Active Noise Control, arranged by P. Sas
- Aircraft Noise, arranged by W. M. Schuller
- Application of Numerical Models to Sound Radiation, arranged by J.P. Coyette
- EEC Legislation in 1993, arranged by D. Commins
- International Standardization — CEN versus ISO arranged by K. Brinkmann
- Noise Control — Shipboard Noise, arranged by J.C. Vellekoop
- Noise Emission Measurements and Standardization, arranged by G. Hübner
- Numerical Models for Sound Transmission in Buildings, arranged by J. Roland
- Outdoor Sound Propagation: Prediction and Control, arranged by K. Attenborough
- Traffic Noises in Urban Areas, arranged by Cl. Lamure

- Tyre Road Noise, arranged by A. Von Meier
- Vehicle Noise — Analysis and Control, arranged by J. Leuridan

INTER-NOISE 93 will provide a wealth of excellent technical papers, good meeting facilities, special hotel arrangements and an exciting social program.

Exhibition

A major exhibition of equipment, materials and instruments will be held in conjunction with INTER-NOISE 93. The exhibition will include acoustical materials and devices for noise control, computational software, noise control instruments such as sound level meters, sound intensity apparatus, sound and vibration spectrum analyzers, noise monitoring equipment, acoustical signal processing systems and equipment for active noise control. This technical exhibition will be presented in two halls adjacent to the technical sessions.

Congress Venue

The Opening and Closing Ceremony and all the technical programs will be held on the City Campus of the Katholieke Universiteit Leuven, College De Valk, Tiensestraat 41, located in the centre of Leuven. The Katholieke Universiteit Leuven, founded in 1425, is one of the oldest and most famous universities on the European continent. Leuven is famous for the beauty of its Gothic buildings. The great Béguinage, the largest of its kind in Belgium, was built in the 13th century. The Gothic style reaches its peak, however, during the 15th century in the church of Saint Peter and the Town Hall. Leuven lies in the heart of Europe only 25 km from the bustling city of Brussels, the home of many pan-European institutions and the *de facto* centre of the Common Market. 1993 in Belgium will be a year of intense cultural, social and technological activity, and is also a year in which Antwerp, just 50 km of Leuven, has the honor of being the European City of Art. Other major cities within 300 km from Leuven include Paris, London, Amsterdam and Köln. The outstanding congress facilities, special hotel bookings and an exciting program make this historic, beautiful and vibrant town the ideal venue for the INTER-NOISE 93 Congress. The sights of Leuven, excellent shopping and the Conference Center are all within easy walking distance of each other.

How To Reach Leuven

By air

Brussels International Airport, just 20 km from Leuven, is served by direct flights from most major European airports and other world centers. There will be a shuttle service on Monday 1993 August 23 at 10.00h, 12.00h and 14.00h, 16.00h between Brussels Airport and the center of Leuven. The travelling time is less than 20 minutes.

From Brussels National Airport a train (Airport City Express) can be taken every 20 minutes to Brussels-North. Tickets may be purchased at the counter (110 BEF) or at a higher fare on board of the train. In Brussels-North, there is a connection with Leuven every hour.

By rail

Most of the trains on the Oostende-Brussels-Liège line stop at Leuven (at least 2 trains every hour).

By road

Near the junction of two important motorways: the E40 and A2.

Table of distances:

Amsterdam	220 km
Brussels	25 km
Köln	200 km
London	300 km
Luxemburg	225 km
Paris	325 km

The Official Air Carrier

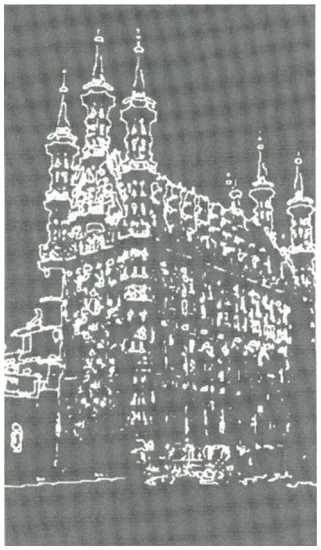
SABENA, Belgian World Airlines, the international airline flying to Brussels from more than 85 destinations on 4 continents, has been appointed the official carrier for the INTER-NOISE 93 Congress. The easiest and least expensive way for participants to reach Brussels is to contact BBL-Travel in Leuven and ask for Mr.Geert Boghe (Telephone number +32 (0) 16-24.91.41 or FAX +32 (0) 16-24.91.45) the local travel coordinator for the congress. Travel facilities and lowest fares will be guaranteed by SABENA. These special fares will be valid before, during and after INTER-NOISE 93 and represent discounts up to 45% of the official rates. In view of these special fares, tickets cannot be changed afterwards. By giving your credit card number to BBL, the ticket will be held at your disposal at the airport of departure (ask for the supervisor).

Hotels and Accommodation

A block of rooms has been booked in several hotels in Leuven which will offer registered delegates and their families special rates before, during and after the congress. To make your reservation, please use the included hotel reservation form and send it to BBL-Travel, Diestsestraat 52, B-3000 Leuven, Belgium, FAX: +32 (0) 16-24.91.45. Reservations must be received by BBL before 1993 June 15 and will only be guaranteed when payment of the total amount has been received by BBL-Travel.

All hotels are centrally located in Leuven and are within walking distance of the congress venue. A shuttle service between the Brussels hotels and Leuven will be provided.

A large number of good quality budget accommodations will be available in the university's residential halls. These rooms, only singles, must be rented by the week (5 nights) beginning on Monday, 1993 August 23, and ending on Saturday, 1993 August 28, . The rate is 4.500 BEF per week, per person and includes bedlinen, towel, breakfast. The rate per extra night single is 1.000BEF. To make your reservation, please use the hotel reservation form on page 32.



Technical Tours

On August 27, two post-congress tours will be arranged to organizations in the Leuven area that are involved with acoustics and noise control.

Please mark the tour you are interested in on the registration form. Tours have to be paid for in advance and seats are allocated on a first come, first served basis. A maximum of 50 seats is available on each tour. Tours are also open to Accompanying Persons. Tours overlap so you can only participate in one tour. The tours include lunches and coffee breaks. All technical tours start and end outside the congress venue at the Katholieke Universiteit Leuven.

The following tours are available:

1. Visit to the Laboratory for Acoustics and Heat Conduction, the Laboratory for Building Physics and the Department of Mechanical Engineering of the K.U. Leuven.

We start with a visit to the Laboratory for Acoustics and Heat Conduction and the Building Physics Laboratory where a presentation will be given on the different research activities. Both laboratories are knowledge centers for education, research and contract research in the field of building and room acoustics and industrial and environmental noise control. Also the test facilities, the anechoic room, the reverberant room, the sound transmission rooms and the semi-anechoic room for model research will be visited. We will then have lunch, after which we will visit the Department of Mechanical Engineering. Demonstrations will be given about structural dynamics and acoustical modal analysis, 3-dimensional sound intensity field mapping, improvement of insertion loss of double-wall constructions by means of active noise control and acoustical simulation calculations with computers.

Start: 09.00 h
Finish: Approximately 17.00 h
Tour Fee: 750 BEF, including lunch

2. Visit to the brewery Interbrew-Stella Artois.

We travel by bus to Belgium's most famous brewery Stella Artois which is in the Leuven area. Stella Artois will show us a film of its activities. After that we will have a short break. Then there will be a guided visit through the brewery and information will be given about noise control management and the different steps in the production of Stella Artois beer. At the end of the visit, before lunch, different types of beer can be tasted.

Start: 09.00 h
Finish: Appromimately 14.00 h
Tour Fee: 500 BEF, including lunch

The same tour will be organized on the same day in the afternoon, starting with lunch at 12.00 h and followed by the visit to Stella Artois.

Social Program

The opening ceremony on the morning of Tuesday, August 24, will be held in the Pieter De Somer Aula at the Katholieke Universiteit Leuven and will include a distinguished lecture and a short musical program. In the afternoon, registered accompanying persons are entitled to a free guided three hour visit to the historical buildings of Leuven. On the same day, following the afternoon sessions, a reception for all registrants and accompanying persons, hosted by our sponsors, will be held at the Faculty Club of the University. On Wednesday evening, August 25, there will be a banquet dinner in the Jubilee Hall of the University and there will be musical entertainment. The banquet is not included in the registration fee and costs 2.000 BEF per person. Due to the limited space the number of participants for the banquet is restricted. Registration for the banquet will be on first-come, first-served basis. Register in good time. On Thursday afternoon, August 26, a closing ceremony and a farewell drink will be offered following the technical sessions.

Delegate and Accompanying Persons Registration

As is customary for INTER-NOISE Congresses, one full delegate registration fee is required for each technical paper included in the program. THIS FEE MUST ACCOMPANY THE MANUSCRIPT AND BE SUBMITTED PRIOR TO 1993 MAY 1. Papers submitted without the registration fee will not be printed in the congress proceedings and will not be included in the technical program. The Registration Desk will be open from 14.00 h to 20.00 h on Monday, August 23, and delegates are encouraged

to register at this time if possible. The Registration Desk will be open from 08.00 h to 17.00 h on Tuesday and Wednesday, August 24 and 25, and from 08.00 h to 11.00 h on Thursday, August 26.

The registration fee for delegates is 12.750 BEF if received earlier than 1993 June 1. For delegates who register after 1993 June 1, the fee is 14.250 BEF. These fees include a set of congress proceedings, participation in the technical program, the opening and closing ceremonies, morning and afternoon coffees, the reception at the Faculty Club of the University and the lunches which will be available on Tuesday, Wednesday and Thursday in the University Restaurants.

The accompanying persons registration fee is 1.200 BEF and includes attendance at the opening and closing ceremonies, the reception and a guided three hour visit to the historical buildings of Leuven.

Registered delegates and accompanying persons may attend the congress banquet at the Jubilee Hall of the University at the cost of 2.000 BEF per person and can also register for the technical tours and specially selected accompanying person's tours as listed below.

Please use the congress registration form which appears in this magazine on page 34.

Payment

All registration fees for INTER-NOISE 93 should be sent to the Congress Secretariat Technological Institute — KVIV, Christine Mortelmans, Desguinlei 214, B- 2018 Antwerpen, Belgium.

Please note that only BANK CHEQUES will be accepted. Remittance must be WITHOUT CHARGES TO INTER-NOISE 93. Cheques in Belgian francs only should be made payable to KVIV Antwerp — INTER-NOISE 93.

Restaurants

Lunches are served at two restaurants on the City Campus of the University and there are several small restaurants featuring continental, Chinese, Japanese and local food in the town. Persons wishing to sample the wide variety of cuisine available have a large choice in Leuven and surroundings. Dining out in Belgium is a delight, partly because of the sheer variety of outstanding restaurants, and partly because of the superb choice of cuisines and dishes to be sampled. Belgium is world-famous for its beers, more than five hundred, and today Leuven is proud to be known as the beer capital of Belgium.

Travel Documents

Please contact the Belgian Embassy (or consulate) in your country.

Useful Hints

We hope that the following information will make your visit to Leuven more enjoyable.

Weather

August is summer in Belgium, with an average diurnal temperature range of 20°C to 25°C, although occasionally the maximum may reach 30°C. On average the weather is sunny with a few days of rain during the month. An umbrella and a light raincoat are advisable.

Electricity

The electric power is 220 V AC, 50 Hz.

Opening hours of banks and stores

Banks are generally open from 09.00h until 15.30h, department stores from 09.30h till 18.00h, while most other shops stay open from 09.00h till 19.00h. Mid-day, most shops generally remain open, although you may find a few that close from 12 noon till 14.00h. On Fridays, supermarkets and department stores are generally open until 21.00h. Money changing after banking hours is available at airports.

BBL Bank and Travel Service

During the congress, BBL will guarantee a bank and travel service between 12 noon to 15.00h. at the registration desk of the INTER-NOISE 93 Congress. The travel service includes: changing tickets, changing hotel reservations, individual trips, receiving the invoice's balance. The bank service includes exchanging money.

Credit Cards

Shops and restaurants usually accept major international credit cards such as EuroCard-MasterCard, Visa, American Express, Diners Club, etc., with a preference for Eurocard-MasterCard and Visa.

Car rental

If you wish to rent a car, it is often advantageous to do so from your own country, often in conjunction with the purchase of your airline ticket. Local car rental companies are: AVIS, Budget, Car Rental, Hertz, and Europcar.

Rules of the road

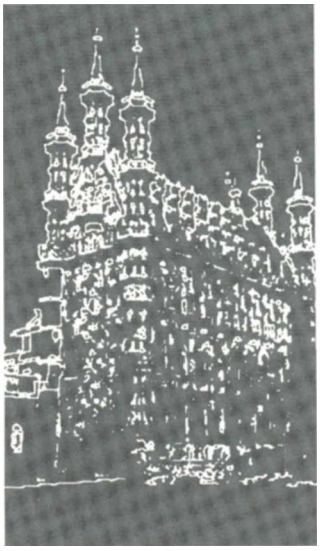
In Belgium, the speed limit on freeways and divided 4 lane highways is 120 km/h. On most other roads, it is 90 km/h, but in towns and cities, you are restricted to 50 km/h. Wearing of seat and shoulder belts is mandatory for both the driver and passengers. In parts of most towns and cities, you have to pay for parking.

Accompanying Persons Program

Leuven Historic Buildings,
Tuesday, 1993 August 24

The Leuven Historic Buildings Visit which has been included in the accompanying persons registration fee has been scheduled for Tuesday afternoon, August 24, departing from the registration lobby. It will comprise a leisurely guided walk through the town with a visit to the great Béguinage, the Saint Peter's Church, the Town Hall, the University Library and other historic buildings. These buildings are all within walking distance of one another. During the visit to the different places of interest, a coffee break and refreshments will be served.

Several tours have been arranged for accompanying persons during the three days of the congress as well as for Friday, August 27 when two activities will take place in the Technical Visits Program. The number of seats for these tours is limited and seats are allocated on a first come, first served basis.



1. The South of Belgium,
Wednesday, 1993 August 25

A one-day tour to the South of Belgium has been arranged. Rendez-vous at the registration lobby at 08.30h. The bus will take you to Dinant, with its Citadel, one of the main tourist centres in the Ardennes. A boat trip on the Meuse will be organized. On our way back we will visit Namur, the boundary between the rocky Ardennes and the undulating fields of central Belgium. Namur is therefore often called "the Gateway to the Ardennes".

The cost of this tour is 2.000 BEF (lunch and coffee break included).

2. Antwerpen, the cultural capital of Europe,
Thursday, 1993 August 26

Departure at 08.30h at the registration lobby. The guide will take you to this rich and lively city, not only because of its world-famous port or industry, but also because of its many historical buildings, such as the Butcher's Guild House, a Gothic white stone and red brick palace; the Steen, the oldest building in Antwerp (12th Century); the Main Square, dominated by the magnificent Town Hall (built in 1561) and Brabo.

A visit will be organized to the beautiful churches such as the Cathedral of our Lady, built in 1352 in the Brabant Gothic Style, and the Church of St. Charles Borromeo, a fine example of the Baroque Style. Antwerpen boasts many other interesting museums such as the Rubens' House, Rockox House, etc.

The cost of this one-day tour is 1.800 BEF (lunch and coffee break included).

3. Brussels, the beautiful capital,
Thursday, 1993 August 26

A one-day tour to Brussels has been arranged and starts at 09.00h at the registration lobby. Brussels boasts the most beautiful square in the world and a large number of particularly fine museums and buildings. A guide will show you the main sights and several visits are planned. The Grand Place consists of the Town Hall (built in 1402) in Gothic Style; the King's House and various guild houses. Behind the TownHall is the bronze statue of Manneken-Pis. The Mont des Arts, with the National Library, the Palace of Dynasty and the Congress Palace, links the upper and lower parts of the city. Brussels has a dozen of museums; only a few of them can be visited such as the Museum of Modern Art and the Horta Museum.

The cost of this tour is 1.800 BEF (lunch and coffee break included).

Two post-congress tours will be organized on Friday, 1993 August 27.

1. Gent, former capital of the Counts of Flanders and Brugge, Venice of the North.

This one-day tour starts at 08.30h at the registration lobby. In the morning we will visit Gent. The old abbeys, such as the Abbey of St.Bavo, St. Peters, the many interesting museums and churches such as St. Bavo's Cathedral with the world-famous masterpiece "the Adoration of the Mystical Lamb"; the St. Nicholas church and the Belfry, they all help to create the atmosphere of Gent. At noon, a typical lunch "waterzooi" will be provided.

In the afternoon, a tour is planned to Brugge. "Brugge the incomparable", the historic heart of Brugge, a unique experience for thousands of visitors. From Market Square (Belfry and Halles) along the City Hall, the Basilica of the Holy Blood, picturesque canals, famous churches (such as St.Saviour's Cathedral, Church of our Lady) and museums (Groeninge and Gruuthuse) to the Béguinage and Minnewater (Lake of Love).

The cost of this tour is 2.000 BEF (lunch and coffee break included).

2. Fashion, gin and nature in Limburg.

This one-day tour starts at 09.00h at the registration lobby. The bus will take you to the Fashion Museum in Hasselt, where you can see the evolution of all styles from the 19th and 20th Century. In an exposition, different themes will be studied such as uniforms, accessories, sportswear and lingerie.

Afterwards, the bus will bring you to the National Jenever Museum, an authentic gin distillery from the 19th Century. The complete production process of gin will be shown.

In the afternoon, a visit is planned to the open-air museum in Bokrijk: a voyage of discovery into the past, an introduction to the life-style and surroundings of our forefathers. Rural and urban buildings from the 15th, 16th and 17th Centuries were transferred to Bokrijk and set up with scientific care.

The cost of this tour is 2.000 BEF (lunch and coffee break included).

Associated Meetings

The Fourth International Congress on Sound Intensity Techniques will be held at CETIM, Senlis, France from 1993 August 31 to September 2, and will be entirely devoted, as the preceeding one, to structure-borne aspects only. The congress will deal with all areas of structure-borne intensity, but an emphasis will be given to further development of measurement and predictive techniques and to improvements in data interpretation and utilization. The congress is expected to expose the state-of-the-art and to point out the future trends on the subject.

A short course on structure-borne intensity will take place from 1993 August 27 to 28, also at CETIM, between INTER-NOISE 93 in Leuven and the Fourth Intensity Congress. The course is designed for acoustics and vibration specialists who wish to become familiar with use of the existing structural intensity techniques in practice. The course will be given by reknowned specialists in the intensity field (Prof. Bernhard, Prof. Heckl, Dr. Maysenholder and Dr. Pavic). For further details on both activities contact the congress secretariat: CETIM Secretariat of the 4th International Congress on Intensity Techniques, Acoustics Department, B.P. 67, 60304 SENLIS CEDEX, France. Telephone: +33 44 58 34 15, FAX: +33 44 58 34 00.

Senlis is a medieval town, situated 45 km north of Paris on the A1 motorway (London - Brussels), 25km from Roissy-Charles de Gaulle International Airport, and 280 km from Leuven via the A1 motorway.

The 18th International Seminar on Modal Analysis and Structural Dynamics will be organized by the Department of Mechanical Engineering of the Katholieke Universiteit Leuven from 1993 August 30 to September 1. This year's events will consist of two short courses, one on Modal Analysis Theory and Practice (1993 August 30-31) and the other on Advanced Techniques in Applied Numerical Acoustics (1993 August 30-September 1). Both courses will be given by reknowned specialists in these fields. For further details on these courses contact the Course Secretariat: K. U. Leuven, Department of Mechanical Engineering, attn. L.Notré, Div. PMA, Celestijnenlaan 300B, 3001 Heverlee, Belgium. Telephone: +32 16286611 — ext. 2482, FAX: +32 16222345.

The first Worldwide SYSNOISE Users Meeting will take place on 1993 August 27-28, also in Leuven and will be organized by Numerical Integration Technologies. Attendees will be able to meet SYSNOISE users and all the NIT Specialists to exchange information. For further information contact: Numerical Integration Technologies, attn. Hilde De Wit, Ambachtenlaan 29, 3001 Leuven, Belgium. Telephone: (32)16400414, FAX: (32)16400422.

INTER-NOISE 93 Abstracts Received

Abstracts with the following titles have been received by the INTER-NOISE 93 Congress Secretariat, and are being considered for presentation at INTER-NOISE 93.

Emission: Noise Sources

• Aerodynamic noise generated by two tandem circular cylinders with different diameters • Estimation of low frequency noise from vibrating highway bridge • Fuzzy similarity nearness and its application in monitoring of machinery transmission system • Influence of operating propeller conditions on the radiated acoustic field • Modelization of the acoustical man-made noise: comparison between models and experiments • Noise control of a wheel loader • Noise emission from glass bottles — prediction and measures • Noise emission of machine tools • Prediction of noise emitted by railway structures • Control of environmental noise in submarines • Development of efficient methods to reduce the noise level of dishwashers • Efficient acoustic sources for high power vehicles noise simulation design principles • High power pneumatic acoustic source for low frequency noise generation development • Noise investigation of a waste gas incinerator • Study on the reference sound source • Active control of radiation from plates by use of modal sensors • Active control of the sound power radiated by an engine enclosure • Analysis and measurement of acoustic noise in ac induction motors subjected to pulsating mechanical loads • Characterisation of fluid machines as acoustics two-port sources • Inverter supplied electrical machines: an approach to predicting vibrations and noise • Investigation of sound radiation from profiled panels by means of nearfield acoustical holography • Investigation of the audible noise around UHF transmission lines in Poland • Noise abatement and control in iron and steel plants • Noise abatement of a fuel pump for motor vehicle by sound intensity method • Noise control in the large cord spinning mill • Noise control of vibrating screens • Noise from the Marnewaard shooting range - a review of sound and annoyance measurements • Noise norms ensuring under designing • On discotheque noise • Simulation and control of noise production from plasma torch in continuous casting processes • Studying on reducing noise of 30ae/aq pumps • Suspension analysis in view of road optimization • The influence of the energy saving measures on the noise of the induction motor • 350 kph running tests to assess a new railway noise model • A test procedure for the measurement of lorry tyre noise • Acoustic impulses of the strong parallel airfoil-vortex interaction • Advanced actuators for active noise control in propeller aircraft • Boundary layer survey on a full scale high speed train by laser doppler velocimetry and aeroacoustic implications • Drum measurements of tire noise as a function of roadway temperature and circumferential

forces • External noise car decreasing of small car • Flight and ground acoustic environment of the C-5A aircraft • Immission relevant sound power level of moving noise sources • Improving experimental modal analysis on complete cars and on mounted subsystems in respect to linearity deviations • Intensity of acoustic energy flux in a flowing medium • Investigation of an airplane-ranking system in relation to the resulting sound pressure levels inside houses • New developments in vehicle pass-by noise measurement and diagnosis techniques • Noise emission by flow around thin smooth body • Noise generation in drive-chain systems due to meshing impact • Noise prediction in the case of moving and evolving sources • Noise radiation from a torsional vibration damper in a diesel engine • Noise reduction of a diesel truck engine with internal stiffeners • Prediction of road traffic noise taking account of transient running conditions of vehicles • Sound power levels of road vehicles: determination by peak or single event levels during pass-by • Subjective and objective assessments of tram noise in Alexandria, Egypt • The assessment of road surface influences on the traffic noise by pass-by level statistics of cars and trucks • The level/time evolution of passing trains to evaluate the noise impact of T.V.G. part I: mathematical development • The level/time evolution of passing trains to evaluate the noise impact of T.V.G. part II: practical validation • Using mechanical-acoustical reciprocity for diagnosis of structure borne sound in vehicles • Variation of noise level from aircraft • About some specific problems encountered in noise control of heat recovery stream generators • Aerodynamic noise from wind turbines • An optimal controller for noise reduction • Establishing a relationship between the flow and acoustic parameters of the turbomachinery inlet tubes • Noise and vibration control in the concrete industry • Noise characteristics produced by ploughs in underground coal mines in Leon (Spain) • Noise control of mechanical parking systems in buildings • Reducing the aerodynamic noise with vanes for diverting flow • Test reverberation chambers for high power vehicles noise simulation acoustical design principles • A finite element analysis of the acoustical characteristics of rooms with sound absorbing materials

Physical Phenomena

• A 3-D boundary element method for determination of acoustic eigenfrequencies considering admittance boundary conditions • A critical review of theater ceiling design based on first reflections • ASPAK II — a 3-dimensional sound propagation package • Attenuation of sound over long range ground-to-ground propagation paths • Noises in offices (investigation of method of measurement and actual condition) • Operative forecast of acoustic noise propagation along ground surface through the atmosphere taking into account meteorological conditions • Physical modeling of marine propellor cavitation noise using a rotating rod as cavitation generation • Scattering characteristics of a quadrupole sound near a stepped surface • Simulation of the discrete sources on a line by loudspeakers • Sound decay in rooms with non-diffuse sound fields • Sound propagation depending on weather conditions caused by ground noises of aircraft • The finite element method as a tool for the description of sound fields at low frequency • Traffic noise propagation under the influence of wind and temperature gradients • Vibration and acoustic radiation of thin-walled structures under aerodynamic excitation • Environmental noise control in nanometer metrology and precision engineering • Localization of aeroacoustic sources using a tridimensional method • Noise generation mechanisms in the flow around rectangular section bluff-body arrays • Noise radiation from rectangular section bluff bodies • On low frequency noise generation in centrifugal fans • Secondary vortex effects on the sound radiation during vortex-wedge-interaction • Sound generated from interaction of large scale disturbances with shock waves • A method of predicting the acoustical properties of layered materials • Absorbing properties of sound scattering structures • Improvement of the spatial Hankel transform method to determine the impedance of outdoor ground surfaces • Outdoor sound propagation over porous road pavements • Sound absorption properties of highly porous concrete • The application of plane wave decomposition of sound fields to selected air-to-water transmission problems • The influence of moisture content on the acoustical properties of model materials for sand • The measurement of air-coupled surface waves over a porous surface • Two indicators for characterizing the degree of coherence in sound fields • Wind tunnel study of 3D sound propagation in presence of a hill and of a wind gradient • Detonation generator of powerful acoustic pulses • Model experiments related to outdoor sound propagation • Noise propagation in the presence of atmospheric turbulence • Screening of noise junctions of a tractor • Studies on the propagation of sound in an inhomogeneous moving medium • Temporal fluctuation of atmospheric acoustic absorption during a year • Acoustic design of new church in Hjerting, DK • Active noise control in rooms for unsteady noises • Effect of barriers on sound field inside enclosed space by ray tracing technique • Finite difference time domain study of acoustical cavities with vibrating plate boundaries • Some analytical aspects in room acoustics • In situ identification of the reflection coefficient of a closed side branch • Measurement of acoustic power for a pipe air flow and correlation with exit pulsation velocity • Numerical evaluation of complex sound intensity fields for noise control • Propagation of non-stationary signals in ducts in presence of a non-uniform flow • Simple analysis of exhaust noise produced by a four cylinder engine • Standing waves in compliant or coated ducts

Noise Control Elements

• A general active noise attenuation system for three dimensional propagation medium • A noise reduction study of an expanded metal press • A study of the absorption coefficient of a practically constructed Schroeder diffusor at normal incidence • A study on the mechanisms of active control of sound • A systematic approach to improve the sound quality of an automotive air-conditioning compressor • Active control of noise generated by fans in ducts • Active control of turbulent boundary layer induced sound radiation • Active noise attenuation inside the automobile cabin • An adaptive matched processing algorithm for active sound control • Application of air borne noise calculation to optimize engines basic investigations • Experimental validation of the prediction model twins for rolling noise • Fast algorithms for multichannel feedforward active control • Feedback control of flexural waves on a beam • Gas turbine acoustic enclosure design by the statistical energy analysis method • In plant screening in petrochemical sites • Noise control for crawler type vehicles by multiple layer structures • Noise control of vehicle cabins • Noise reduction of vacuum cleaner • Noises control of tram car noise by grinding the rails • Novel sound absorbent elements for noise barriers • On a better noise control choice for heavy vehicles • On the feasibility of railway noise reduction by using local porous surfaces • Parametric inversion of enclosed sound fields; application to active noise control • Performance of active noise control systems in commercial and industrial systems • Railway wheel acoustic optimization • Reduction of the emitted noise at a generator installed in building • Sound control and noise isolation of the ZEA (Zona Equipamiento Audiovisual) pabellon medioambiente ini, International Expo Sevilla • Study on

active noise attenuation in three-dimensional sound field • Study on noise reduction by T-shaped barrier • Synchronous algorithms for active noise and vibration control • System for assembling and evaluating characteristic machinery noise emission data • The influence of finite reflecting surfaces upon fan noise spectra — a case study • A method for the calculation of noise attenuation by finite length barrier • Applications of noise abatement devices at the top of highway noise barrier • Acoustics insulation of prefabricated aluminum and steel panels • Airborne sound insulation of plaster panels • Influence of sound absorbing material type and location, stud type and spacing, and screw spacing on the sound transmission through a double panel wall specimen • Sound transmission through suspended ceilings • The sound transmission of cavity walls due to studs • Use of sound intensity method to compare sound reduction index of tractor windows supported in various ways • Active noise control of a large industrial fan • Analysis of resonator mufflers with dynamic terminations • Application of numerical methods to three-dimensional acoustic fields for active noise cancellation • Computer prediction of exhaust system performance • Design of double-decker microperforated panel sound absorption structure and its application • Finite element analysis of absorption silencers • High intensity discrete frequency noise abatement on industrial plants • Muffler design through non-dimensionnal four-pole modeling and direct impedance measurements • No-media silence design based on micro perforation theory • Transmission loss of a compressor silencer using boundary element modelling • Estimation of acoustical parameters for porous asphalt design • Preparation and properties of magnetic-vibration-damper • The measurement of absorption coefficients at arbitrary angles of incidence using spatial Fourier transformation • Active/passive noise control for ship system ducts • Development and test of active attenuator of noise in inlet ducts of ventilators • Noise of gas handling systems • Some theoretical aspects of a dynamic treatment method useful for the fan generated noise suppression • A method to increase the convergence speed by using uncorrelators in the active control of multiple noise source • Active control of structural vibration and sound radiation: I theory • Active control of structural vibration and sound radiation: II. adaptive active controller and experimental analysis • Active enclosure for control of vibratory feeder bowl noise • An effect of the transfer functions from the secondary sources to the error sensors on the performance of the active control system • An experimental study on adaptive active control of underwater noise by use of ilms algorithm • Chain and cable as high frequency vibration absorbers • Frequency domain adaptive control algorithm for electronic muffler applications • Influence of acoustic time delays on the attenuation effects of adaptive active control system • New applications of rubber-metal composites to noise and vibration control problems • Optimization of active noise control systems in enclosures • Study of the theory of local active noise absorption • Theoretical analysis and physical mechanism for adaptive active broadband noise control

Vibration and Shock: Generation, Transmission, Isolation and Reduction

• Acoustic fatigue in aeronautics: overview of existing test facilities in Europe • Calculation of sound radiation from complex vibrating structures by a superposition method • Noise reduction of brake for washing machine • Optimal controller for system with flexible modes • Optimal noise and vibration absorbers for elastic surface systems • Power transmission and radiation for structures coupled via large contact areas • Reduction effect of ground vibration due to vibration proof mats • Sound transmission through cavity walls • Study of the effect of the plate stiffeners on the structure-borne noise transmission on-board ships, using statistical energy analysis • The vibration of the foundation caused by working machine • Underwater and inboard sound path analysis of a resiliently mounted engine • Vibration and noise of rotor machinery with large sized gear • Vibration damping steel sheet for automotive noise control • Vibrational power minimization and absorption in Euler — Bernoulli beams • Noise prediction method for ship passenger accommodation • Noise reduction of portable electric drill • Active control of power input in a plate: comparison of feed-forward and feedback methods • Bending vibrations of ribbed plates • Effectiveness of the hull surface compliance to reduce the propeller-induced ship vibration • Green functions synthesis for vibration and sound radiation prediction at non-uniform structures • Identification of vibration sources in beams and cylindrical shells using theory of potentials • Influences of air bubbles on vibration and noise levels of water filled pipes • New design of a barking drum as a result of acoustical investigations of its models • On the point mobility of thin infinite plates • Piezoceramic transducers vibration active control capability • Sound scattering by limited cylindrical shells • Sound transmission loss of concrete structure taking solid-borne sound into consideration • Structure borne noise from rotor blades or wind turbines • The investigation of the travelling wave resonance of passive bevel gear • The shell vibration in the case of the dispersion equation roots degeneration • Vibrations of a tube bundle under excitation of sound waves • An investigation of vibrational wave transmission across complex joints in pipes • Measurement of moment mobility using a moment actuator • Modeling of boundary conditions when treating a ship construction as an acoustical wave guide • On the structure-borne noise of a cruise ship • Prediction of power flow and vibration energy dissipation of connected beams via frequency response functions for power variables • Prediction of shock propagation in coupled-beam systems • Radiation efficiency of rectangular plates under different boundary conditions • S.E.A. of two plates — a wave solution • Sending wave transmission in multi-connected plates • Structure borne sound between elastically coupled plates • Structure borne sound diminishing through viscoelastic joints in pipe installation • Study of relation between vibration and sound radiation from submerged damped stiffened roof-cutting conical shell • Vibration into buildings • Ashdown environmental limited methodology for the prediction of re-radiated underground train noise in residential buildings • Active vibration control in pipes • An improved squeeze film damper as flexible support for jet engine rotors • Control channel synthesis for linear and nonlinear active vibration isolation systems using fixed point method • Wave effects in elastomeric isolation pads — experimental evaluation • Finite element modeling of structures with discontinuously constrained damping covering • Four parameter fractional derivative model of viscoelastic materials • A research on floor impact vibration of steel framed prefabricated houses • Train-induced vibrations on persons in buildings

Immission: Physical Aspects of Environmental Noise

• A study of impact noise transmission through floating floors • A study on loading noise of non-cavitating marine propellor • An investigation of the improvement in sound environment of open plan offices • Complex evaluation of territories including noise factor • DPA: the active controlled double wall • Laboratory experiments on loudness of floor impact sounds • Measuring and testing the night noise pressure level of a plant from the point of view of the surrounding living houses • Noise reduction on the river ships • Predicting noise

levels in urban environment, using calibrated ray-tracing models • Prognosis of noise and vibration levels in living quarters of offshore platforms measurements versus calculations • Quiet apartments above a subway line: a case study in Lyon, France • Revised guide for measuring and calculating industrial noise • SEA as a predictive tool to improve sound insulation between dwellings • Sound insulation of variable rigidity shell • Structure-borne sound transmission at low frequencies using statistical energy analysis and finite element methods • Insulation of structure borne sound of concert hall from railroads • Methods for measuring and identifying flanking transmission in wood-framed construction • Noise and vibration propagation in building renewal and occupants noise evaluation • Predicting in situ sound insulation • Prediction of sound dwellings: a European approach • Prediction of the sound reduction of profiled metal cladding • Aircraft noise exposure modeling is usage as a planning tool restricted due to (in)accuracy • Comprehensive assessment of environmental noise from petrochemical complex • Experimental measurement of vehicle insertion loss • Fundamental inadequacies of standard noise measurements around airports to assess the annoyance to the communities • Improvement of the method to represent the horizontal distribution in flight tracks in calulating the aircraft noise load • Including topography in airport noise calculations. sound propagation aspects. • Measurement of the influence of buildings on road traffic noise immission by a correlation method with maximum length sequences • Noise versus people • Practical tests of the Nordic prediction method for road traffic noise — predicted values compared to measured values • Simulation of community noise from the existing large factory • Study of the existing methodologies for the calculation of aircraft noise load in the EEC member states • Vision efficiency as the physiological indicator of noise effect on man • AKURI — a quick model to predict noise files in industrial interiors • Effective plant noise modeling for a large refinery complex • Acoustic design criteria and noise control features for a modern GRP minehunting vessel • Dynamic characteristics of cross-stiffened, parallel plates • Mechanical impedance and natural vibrations some ship structures • Noise level inside ship accommodation depend on acoustic power radiated by a cabin window • Sound radiated by a ship's hull plate • A study of time interval in measuring urban noises • Environmental noise regulations in the community of Valencia (Spain) • Spectrum analysis of environmental noise in China's urban community • The effect of aircraft noise on the hearing of the airport staff at the Kotoka International Airport, Accra, Ghana

Immission: Effects of Noise

• Activity and sleep interference: a new measurement technique • An outline of the study of toy noise influencing on the school-children's knowledge • Annoyance of noise from wind turbines • Comfort and discomfort zones at the infrasound effect • Disco-music and hearing loss amongst young adults • Health effects of military low-altitude flight noise • On revealing of zones of infrasound harmful effect on a person's organism in conditions of real production • Recent developments with respect to aircraft noise and sleep disturbance • Workers' exposure to noise in power plants • Annoyance from inverter-fed induction motors • The significance of psychic alterations for the vegetative processing of noise • Adaption of booming nature of sound • Noise annoyance and the Lombard effect • On the use of artificial neural networks to model human annoyance due to noise • Phychological evaluation of noise in passenger cars using the method of continuous judgement by category — effect of visual monitoring • Psycho-acoustic study on the effect of duration on the annoyance of helicopter noise using time compressed or expanded sounds • Psychological evaluation of noise in passenger cars using the method of continuous judgement by category — analysis in different noise sources • Attitudes to highways, railways and tramways • How much important do people think quiet is for a residential environment? • The problem of nuisance noise at night • Pricing of traffic noise in road planning • Noise prediction at new Athens airport "Eleftherios Venezelos" by application of the integrated noise model, based on meteorological effects • The expected effects of environmental noise of the World Expo '96 • A laboratory installation for the subjective evaluation of noise from heavy weapons • Evaluation of air distribution noise quality in cars • Evaluation of timbre of air conditioner noise • Probability distribution of equivalent continuous A-weighted sound pressure level • Simulating loudness and damage-risk from impulse noise • Subjective tests of impulse noise annoyance and the listening environment

Analysis

• independent review of current outdoor noise propagation calculation methods • Analysis of the noise annoyance produced to the underground railway passengers • Application of four microphone technique in acoustic intensity measurements and finite difference approximation error analysis • Automated background noise qualification for in-situ sound power determination • Determination of the number of independent input transducers for system models • Development of an estimation procedure for noise at receivers remote from the source • Effect of aperture size and microphone spacing on the acoustic holographic prediction of sound fields • Indirect force measurement at interfaces of complex machinery • Investigations of the limits of the sound intensity scanning method determining sound powers • Laboratory methods for calibration of intensity probes • Measurement of acoustic intensity vector in duct with flow • Measurements of sound attenuation of hearing protectors at artificial and human heads • More accurate noise measurements of machinery in factory halls by removable absorbing screens? • On the accuracy of numerical methods in acoustics: comparison of measurements and calculations • The accuracy of scanning sound intensity method in sound power level determination • The boundary element technique as a tool for the design of a noise protection hangar for jet engine testing on giant aircraft • The development of the real time octave band analyser using digital signal processing technique • The relationship signal — mathematical model as the basis of processing system • Wave number filtering with double-layer cylindrical antenna in acoustical holography • A simple vibrational volume velocity transducer • Calibration signals for meters of loudness, sharpness, fluctuation strength and roughness • Measurement of plane wave pressures in airflow duct by two-microphone method in slit-tube midway • Microphones for peak pressure measurements • Sound calibrator based on silicone reference transducer • The development of I.E,C. sound intensity instrument standard • A measurement method to analyze the railway vehicle noise • A method to estimate the acoustic holography using a sub-array decreasing the effect of other sound sources and reflections • A second generation acoustical coupler for phase match of microphones • A short method for the determination of airborne and impact sound insulation: methodology and experimental results • A three-sensor method for the measurement of the one dimensional vibration intensity with three sensors • Accuracy of emission sound pressure levels • Acoustic studies of switched reluctance motors • Acoustical characterization of material in industrial shops by TOS and impulsive methods • Aircraft interior sound field analysis in view of active control: results from the Asanca Project • Application of acoustical hologra-

phy to noise source detections of an operating maglev vehicle • Combining up to date vibration analysis techniques and composite isolation material technology: a highly effective approach for optimization of floating floors in sound-sensitive areas • Development of a test set-up for objectively measuring hearing protectors • Investigation of window shapes for estimating discrete frequency components by FFT • Measurement of sound insulation at low frequencies • Measurement of sound pressure levels with intensity technique • Multi-reference nearfield acoustical holography in reflective environments • Noise emission measurement of foundry machines and standardisation of a measurement procedure • Noise source localization on high speed trains using different array types • Nonlinear vibration and acoustic coupling effects in structural acoustic tests of panels • Passive method for determination of vibration impedance of complex structures • Sound power determination by intensity measurements on a rotating source in a reverberation room • Spatial integration of vibration with a volume displacement microphone • Studies to evaluate the signal characteristics of series fractional horsepower motor • The time windows for estimating transfer function by cross spectral method • Using maximal-length sequence methods for the measurement of high values of isolation • Design and commissioning of a new floor sound transmission facility • Development of low noise wind tunnel for aerodynamic noise research • Inter-laboratory comparisons of low frequency sound transmission: conventional and intensity measurements • Inter-laboratory comparisons of low frequency sound transmission: narrow band measurements and computer simulations • A multichannel optimal block adaptive algorithm for active noise attenuation • A new digital filter system specialized for active control of noise parallelled digital filter • A simplified multichannel adaptive active noise control scheme • Analysis of the acoustic signal structure of the automatic double press • Delayed-x LMS algorithm for ANC of plane wave • Detection of signal wave by use of a threshold filter • Interfering noise reduction in sound intensity measurement using a microphone array with consideration of wavelength constant • Noise suppression for hands free mobile telephone communication • Source identification via MISO modeling application to engine room noise of a passenger car • Speech parameters extraction in noisy environment using masking model • The application of phase-magnitudes demodulation of vibroacoustical signal in the diagnostics of local failures • Time frequency discrimination of fluid and structure borne paths in a liquid filled elastic cylinder • A sub-structute shell method to analyze the dynamics of complicated shaped gear • Acoustic optimization of complex closed shells equipped with interior structures by numerical methods • Active minimization of acoustic potential energy inside structurally coupled enclosed spaces • Energy flow coefficients for an L-shaped plate combination • Evaluating the transmission loss of muffler in exhaust system of diesel engine using 1/H(f) • Prediction of the sound field radiation from vibrating cylinder in three-dimension half-space by boundary element method • A coupled FEM/BEM model for designing axisymmetrical acoustic transducers • A general procedure for coupling acoustic finite elements and boundary elements • A global acoustic sensitivity procedure for structural optimization • A refined model for composite treated panels as used in automotive industry • Acoustic radiation from a finite plate with random mechanical and turbulent excitations in a uniform subsonic flow • Aircraft structural elements vibration active control numerical simulation • An approximate calculation of the acoustic output from interfering jets • An overview of boundary element approaches for acoustic modelling • Analysis of main bearing impact induced by crankshaft vibration • Application of noise source ranking techniques • Applications of the conical beam method in architectural, industrial and environmental acoustics • Bench-mark on acoustical ray tracing computer programs • Combining SEA and FET modeling for prediction of local vibrations: application to a beam network • Comparison of three computer models for the prediction of sound propagation in an enclosed space • Estimation of low frequency noise from submerged exhaust exit • Estimation of source strength of vibrating structures by using BEM and reciprocity • Experimental vibro-acoustic system modeling in the medium frequency area: an impedance modelling approach • Impact sound insulation of carpets predicated by carpet compression • Loss factor determination for statistical energy analysis on a fully assembled diesel engine • Numerical evaluation of acoustic interactions between transducers • Prediction of vibration and noise of gear box • Research on impacting force identification based on optimal physical model • Sound radiation from a circular plate: comparisons between numerical prediction and experimental results • Structural-acoustic interaction in an air intake system of a truck • Study on sensitivity analysis for radiated noise • The equivalent sources approach to acoustical designing of forced vibrating structures • Twins = a prediction model for wheel-rail rolling noise • Two stage NARMAX modeling-application to a speaker system • Wave: envelope element formulations for exterior acoustic problems status and projections • A comparison of classifier methods to detect abnormal behaviour in reciprocating pumps • An adaptive algorithm for ship equipment vibration monitoring and condition diagnostics

Requirements

• A national plan of action against noise; acoustic research in the frame of the Commission of the European Communities • Contribution of tire road noise to the type approval measurement results of motor vehicles — conclusions for further development of noise limits and measurement procedures • Different results of sound power measurements as a consequence of standardization? • EEC legislation in 1993 • Experience with traffic noise restraint measures in Germany • Law as an instrument of noise control • Noise abatement policy in Germany and in the EEC • Noise emission standardized measurements of woodworking machines and determination of their uncertainties • Noise requirements for night operations of airports • Reducing annoyance caused by industrial noise: the Dutch treatment • Results of a long-term program concerning noise control of industrial workplaces • Round robin test determining the sound power by sound pressure measurements according ISO 3744 • Sound intensity standard for determining sound power of computer and business equipment: ECMA-160 and ISO/DIS 9614-2 • The making of an airport noise standard • An investigation of measurement uncertainties in the determination of machinery sound power levels • DIN 45648 — a standard for measuring the noise emission of municipal vehicles — experience in using and comparison to other standards • Evaluation of the applicable standards for the declaration of noise emission values of refrigeration type compressors • Normalized noise spectra comparison with results obtained under Polish conditions • Progress in the development of international standards for determining sound power levels and emission sound pressure levels of noise sources • Results of joint work of ISO/TC43/SC2 "Building Acoustics" and of CEN/TC 126 "Acoustic properties of building products and of buildings" • Standard design of low noise machinery • The European approach to technical harmonization and its effect on standardization in acoustics • The Dutch noise abatement law calls for a coupling of individual sound regulations with the zones • Studies to declare emitted noise levels of the household appliances

INTER-NOISE 93

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TECHNICAL VISITS			
on 1993 August 27			
1. Visit to the Laboratory for Acoustics, Building, Physics, Mechanical Engineering-KULeuven	750	_____	_____
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Subject Classification

For several years, International INCE and INCE/USA have used the following subject classification for organizing papers at INTER-NOISE Congresses. The listing below is version 5.2, and was prepared in 1993 January. Comments and suggestions for changes are welcome, and should be addressed to Dr. William W. Lang, President, International INCE, P.O. Box 3067 Arlington Branch, Poughkeepsie, NY 12603, USA.

GENERAL

00 General
01 INTERNATIONAL/INCE
02 INTERNATIONAL/INCE (Continued)
03 INTERNATIONAL/INCE (Continued)
04 INTERNATIONAL/INCE (Continued)
05 Publications (other than technical articles)
06 History and philosophy
07 Education
08 Noise programs
09 Definitions and descriptors

EMISSION: NOISE SOURCES (Noise generation and Control)

10 General
11 Noise-generating devices (including components and subassemblies)
12 Stationary noise sources (noise generation and control)
13 Moving noise sources including aircraft (noise generation and control)
14 Specialized industrial machinery and equipment

PHYSICAL PHENOMENA

20 General
21 Physical mechanisms of noise generation
22 Natural sources of noise
23 Propagation, transmission and scattering of sound (general wave equation)
24 Sound propagation in the atmosphere
25 Sound propagation in enclosed spaces
26 Sound propagation in ducts

NOISE CONTROL ELEMENTS (Noise control by external treatments)

30 General
31 Barriers and screens; shielding
32 Enclosures for noise sources
33 Sound isolating elements including panels, partitions and curtains
34 Filters, mufflers, silencers and resonators
35 Absorptive materials
36 Hearing protective devices
37 Noise attenuation and transmission in ducts
38 Special treatments

VIBRATION AND SHOCK: GENERATION, TRANSMISSION, ISOLATION AND REDUCTION

40 General
41 Characteristics of sources of vibration and shock
42 Vibrating surfaces and structures (beams, plates, shells)
43 Propagation in structures (structure-borne noise)
44 Balancing of rotating and reciprocating machines
45 Reduction of impact forces; shock isolation and absorption
46 Vibration isolators and attenuators
47 Vibration-damping materials and structures
48 Vibration generators, shake tables
49 Effects of vibration and mechanical shock (on man, on structures)

IMMISSION: PHYSICAL ASPECTS OF ENVIRONMENTAL NOISE

(Multiple sources and multiple paths)
50 General
51 Building noise control
52 Community noise control
53 In-plant noise control
54 Shipboard and offshore platform noise control
55 Plant design and construction
56 Noise surveys

IMMISSION: EFFECTS OF NOISE

60 General
61 Perception of sound
62 Physiological effects
63 Psychological effects
64 Effects of noise on physical structures
65 Effects of noise on animals and other wildlife
66 Sociological effects; community reaction to noise
67 Economic effects
68 Environmental impact statements
69 Criteria and rating of noise

ANALYSIS

70 General
71 Instruments for noise and vibration measurement
72 Measurement techniques
73 Test facilities (design and qualification)
74 Signal processing
75 Analytical methods
76 Modeling, prediction and simulation
77 Sampling and quality control procedures
78 Audiometry, dosimetry and hearing measurements
79 Psychoacoustical evaluations and testing

REQUIREMENTS

80 General
81 Standards
82 Federal government legislation and regulations
83 State legislation and regulations
84 Other legislation and regulations
85 Ordinances, including zoning requirements
86 Building codes
87 Specifications
88 Auditing, enforcement and certification
89 Labeling

RESERVED FOR FUTURE EXPANSION

90 - 100

European News

A. Cops, *European Editor*

EUROPEAN COMMUNITY

Five European Organizations Receive Joint Funding for Training Program. Five organizations have received support from the European Community program for a project called SAVOIR— training in Sound and Vibration: Organization, Information and Resources. The project is focused on European training in the field of sound and vibration and the grant assists in the development of a comprehensive training program.

SAVOIR training is aimed at a wide range of industries. The types of industry which would be expected to follow the SAVOIR programs include instrument manufacturers, the automotive, aerospace, rail transport and building industries, machine/tool, domestic appliance, musical instrument manufacturers and the audio industry.

Subject areas include occupational and environmental noise, measurement techniques, noise control and machine design, silencers, ducts and enclosures and machinery condition monitoring and fault diagnosis. Training is provided through traditional "classroom" courses, multimedia packages including interactive video disk and distance/open learning. SAVOIR initially involves five members: the Institute of Sound and Vibration Research at Southampton University (UK), Technisch Physische Dienst (TNOTH) at Delft (NL), Metravib RDS and Ecully (F), Brüel and Kjær at Nærum (DK) and the Acoustics Laboratory at the Catholic University of Leuven (B). Within three years, it is hoped that the membership will extend to all EC countries.

"The purpose of the SAVOIR program will be to identify the real needs of industry" said coordinator Dr. John Walker of the Institute of Sound and Vibration Research. "The partners in SAVOIR have the marketing skills which will enable the identification and fulfillment of special needs and the expertise to advise on the most effective training methods. We can also offer a wealth of experience and ensure the correct balance between academic skills and practical applications." Further information may be obtained from Mrs. Maureen Strickland, SAVOIR Secretariat, ISVR, University of Southampton, Southampton SO9 5NH, United Kingdom.

SWEDEN

Action Plan Against Noise

The text below is in the form of a resolution (1992:20) of the Swedish Cabinet passed at a meeting on 1992 February 13. The Presenter was Mr. Olof Johansson, Minister of the Environment and Natural Resources. The task of preparing the plan was given to Dr. Tor Kihlman of the Chalmers University of Technology in Gothenburg, Sweden. Dr. Kihlman is expected to complete the plan in the summer of 1993. - Ed.

My proposal

I propose that a special investigator be instructed to prepare an integrated Action Plan against Noise.

Background

In the autumn of 1990, Parliament resolved that an integrated Action Plan against Noise should be submitted to Parliament without undue delay (JoU 1990/91:17, rskr. 27). It is the view of the Government that noise pollution should be reduced and that each sector concerned should implement noise control measures commensurate with its responsibility for the environmental impact of its activities.

The Standing Committee on Agriculture has pointed out the need of a comprehensive analysis and a programme with respect to noise in work, housing, and leisure environments (JoU 1990/91:30, rskr. 1990/91:338). In its report, the Committee emphasized the importance of an integrated programme in the light of the problems caused by noise. Parliament adopted the Committee's proposal.

The need for an integrated Action Plan

Noise pollution is increasing as a result of heavier traffic, the use of noisy machinery, increased ventilation and an increase in the use of power-operated tools, stereo systems with amplifiers and household appliances.

Noise pollution is an international problem and has lasting effects. In a large number of sociological surveys carried out in various countries, noise is ranked as one of the most intrusive environmental factors in both work and housing environments. Hearings defects due to noise are irreversible. And there is no prospect in the near future of replacing today's noisy machines with quiet ones.

In Sweden, the responsibility for noise control measures rests with various authorities, e.g. the National Environmental Protection Agency, the National Board of Housing, Building and Planning, the National Road Administration, the National Road Safety Office and the National Board of Occupational Safety and Health. These authorities have issued directions, instructions, guidelines and recommendations relating to noise.

External environments

Major sources of noise in the external environment are traffic, industrial plants, building sites, shooting-ranges, amusement parks, etc. The chief source of noise is traffic. In 1974, it was estimated that 2.5 million Swedes were exposed to disturbing traffic noise.

On the basis of subjectively perceived problems such as sleep disorders, 750,000 of these were considered very disturbed (source: Traffic Noise Report, SOU 1974:60). The situation today is worse due to the increase in the amount of traffic.

However, far-sighted physical planning can reduce much noise pollution from road and rail traffic, airports, industrial plants, motor sports tracks, and shooting ranges.

Work environments

Noise pollution is a serious problem in many workplaces. The number of workers who are exposed to noise is substantial, despite the decrease in the number of noise-induced hearing impairments re-

ported in recent years. The noise situation in the most affected workplaces can be greatly improved by careful planning. Insufficient knowledge of preventive measures represents an obstacle to the improvement of noisy environments. Faster machines and processes often necessitate radical noise suppression, which can usually only be achieved by extensive research and development and substantial investment. The Commission on the Work Environment (SOU 1990:49, Appendix A) has produced a report containing an evaluation by the National Board of Occupational Safety and Health of measures in the noise pollution area.

Housing environments

Noise nuisances in housing environments are usually due to outside activities. Disturbance caused by the neighbors and low-frequency noise from household machines and installations, usually due to defective insulation, are also very common.

Defective construction is also quite frequent. This is rarely detected, since sound insulation checks are very seldom carried out. Another important reason is that compliance with sound insulation standards is not necessarily a guarantee of satisfactory sound insulation.

Noise in leisure environments

Both loud noise levels that can damage hearing and low levels, whose detrimental effects are mainly of a psychological nature, occur in leisure environments. Hunting, power-operated tools, boat engines and loud music are among the commonest sources of disturbance in leisure environments.

Noise levels with a psychologically disturbing effect can also be damaging to sensitive natural environments. A separate investigation has been commissioned to study noise in mountain areas and archipelagoes (Dir. M 1991:78).

Reduction of noise at source

It is generally most cost-effective to deal with noise at the source. This applies both to industrial machinery and many consumer products.

This question is dealt with in the European Community Directive relating to Machinery (89/392/EEC, OJ no. 183/89) which requires noise information to be declared on all machinery, from household mixers to excavators, that emits levels exceeding 70 dBA at a distance of 1 metre. As of 1993 these requirements will be applied throughout the EC, and Swedish exports to the EC will have to comply with them.

Research and education

There is at present a lack of acoustically trained personnel. This is due to the interdisciplinary nature of acoustics, which requires a knowledge of subjects that are all taught at Swedish institutes of technology, but which are spread out over different study courses. Both research and development, and education have been neglected in this area.

Terms of reference

As has been explained above, very little has been done to deal with the problems caused by noise. In my view, greater importance must be attached to noise prevention and control. A special investigator should be appointed for the purpose of preparing an integrated Action Plan against Noise.

Using the surveys currently being carried out by the National Road Administration, the Civil Aviation Administration, the National Rail Administration, the National Board of Housing, Building and Planning, the Greater Stockholm Public Transport Company and the Fortifications Administration, as well as by several municipalities, as a guide, the investigator should describe the situation as regards noise and the degree of annoyance that it causes. He should also draw on the evaluation of noise control measures made by the National Board of Occupational Safety and Health.

The Action Plan should include proposals in the following areas: noise suppression at source, the external environment, work environments, housing environments, leisure environments, and research and education. The aim of the plan should be to reduce the number of people who are exposed to noise disturbance. It should be directed at concrete measures with a realistic prospect of implementation. It should also include preventive measures. A separate investigation was set up in 1991 August to study noise in mountain areas and archipelagoes (Dir. M 1991:78).

The various agencies with responsibility for road, rail, and air transport have performed environmental analyses in which they set forth their views on problems related to noise and propose certain measures.

The investigator should analyze the above proposals and consider how they should be integrated into an Action Plan, on the principle that the most cost-effective measure should be taken first. The division of responsibilities between the parties concerned should be determined.

It is important that the problem of noise be taken into account in municipal planning and in environmental programmes. Greater importance must be attached to physical planning as an instrument of environmental policy. Municipalities should be involved in the integrated Action Plan against Noise, and existing planning expertise should be made available to help them in this work. The findings of the investigation on noise in mountain areas and archipelagoes (dir. M 1991:78) should be used in this connection.

The investigator should also propose measures to promote the development of housing with adequate sound insulation, taking into account the proposals for simplification of the rules governing housing construction set forth in the report on Government support for the financing of housing (Dir. 1991:107).

The Action Plan should also include an analysis of the need of research and development in the field of acoustics and noise suppression with a view to ensuring a sufficient supply of acoustics expertise for industry and the public sector.

As regards the effects on industry, the investigator should take as his point of departure, the Government's new industrial policy, the objective of which is to improve business conditions in Sweden by the implementation of general economic policy and deregulation. Moreover, the proposals should be formulated in such a way as to be neutral from the point of view of competition and to avoid technical barriers to trade.

One of the investigator's priorities

must be to submit detailed cost estimates, including estimates of the cost to the national economy of achieving the goals and implementing the measures proposed by the investigation, as well as proposals as to financing. The investigator should also indicate the social rate of return that may be expected as a result of reducing noise pollution.

Time scheme, methods of work, etc.

The investigation should be completed by 1993 July 1. The investigator should submit a plan of the investigation to the Ministry of the Environment and Natural Resources before 1992 May 1. He should be free at any time to present proposals on individual measures that can be implemented speedily.

The investigation will be subject to the directives issued to all committees and investigators concerning the orientation of their proposals (Dir. 1984:5) and consideration of the European Community aspects (Dir. 1988:43).

Request

With reference to the report presented above, I hereby request that the Government authorize the Minister of the Environment and Natural Resources:

- to appoint a special investigator, subject to the provisions of the Committees Ordinance (1976:119), for the purpose of preparing an integrated Action Plan against Noise; and
- to appoint advisers, experts, secretaries and other staff to assist him in his task.

I also request that the Government resolve that the costs of the investigation be charged to the appropriation for Committees, etc., under the Estimate for Parliament and its Agencies.

Resolution

The Government endorses the conclusions of the presenter and grants his request. (Ministry of the Environment and Natural Resources)

RUSSIA

St. Petersburg Hosts a Transport Noise Symposium. On 1992 October 6-8, the East-European Acoustical Association (EEAA) held an international symposium on "Transport Noise and Vibration" in St. Petersburg, Russia. Eighty papers were presented in the following areas:

- theoretical and experimental investigations of vibration and radiation from transport structures,
- methods for vibroacoustic investigations and diagnostics,
- methods for the control of noise and vibration in transport vehicles,
- results of measurements and predictions of transport noise and vibration,
- problems related to acoustics in a moving medium,
- health effects of transport noise and vibration.

Other topics discussed included noise problems in cars, ships, aircraft, trains, and other means of transport. About 200 scientists and specialists in noise control participated in the symposium - from Russia, Ukraine, Byelorussia, Lithuania, Georgia, Germany, USA, Sweden, Italy, Switzerland, Denmark, The Czech Republic, and China.

An exhibition of instruments and other equipment for control of noise and vibration was held during the symposium. Exhibitors included Inter-Keller AG (Switzerland), Brüel and Kjær (Denmark), Krylov Shipbuilding Research Institute (Russia), and Planeta-Komplex (Russia).

The symposium chairmen were the president of the EEAA, Professor A. Nikiforov, and Professor M. Heckl from the Technical University of Berlin. The chairman of the organizing committee was Professor A. Ionov, head of the department of foreign activity of the EEAA. The primary sponsor of the symposium was the Krylov Shipbuilding Institute in St. Petersburg.

Detailed information on the symposium can be obtained from the Secretariat of the East European Acoustical Association, Moskovskoe Schosse 44, 196158 St. Petersburg, Russia. Telephone: +7 (812) 127-93-48; FAX: +7 (812) 127-93-49. The next symposium on the same topic will be held in St. Petersburg on 1994 Oc 4-6. —*A. Nikiforov*, St. Petersburg.

East-European Acoustical Association is Formed. At its second congress on 1992 April 24, the former All-Union Acoustical Association changed its name to the East-European Acoustical Association. Professor A. Nikiforov from the Krylov Shipbuilding Research Institute was elected president of the association following the death of Professor V. Liapunov. At present, there are 500 members of the association in several divisions— the St. Petersburg division headed by Professor Nikiforov, the Moscow Division headed by G. Osipov, the Kiev division headed by V. Grinchenko, the Southern division headed by G. Nerubenko, and the Kazakhstan division headed by S. Omarov.

The Association also has several scientific/technical sections. In St. Petersburg, there is interest in noise and vibration control, electroacoustics, ultrasonic techniques, medical acoustics, mathematical acoustics, hydroacoustics, acoustical measurements and apparatus, noise and vibration excited by flow, ecological problems in acoustics, piezoelectric materials, speech and hearing, and acoustical signal processing.

In the Moscow division, the main interest is in architectural and building aco.ustics, noise and vibration from surface and underground transportation systems, aircraft noise, and industrial noise. Work at the Kiev division involves the acoustics of shell structures; in the Southern division there is interest in ferrohydrodynamics, and vibroacoustics. Acoustical materials, industrial noise, and mathematical acoustics are emphasized at the Kazakhstan division.

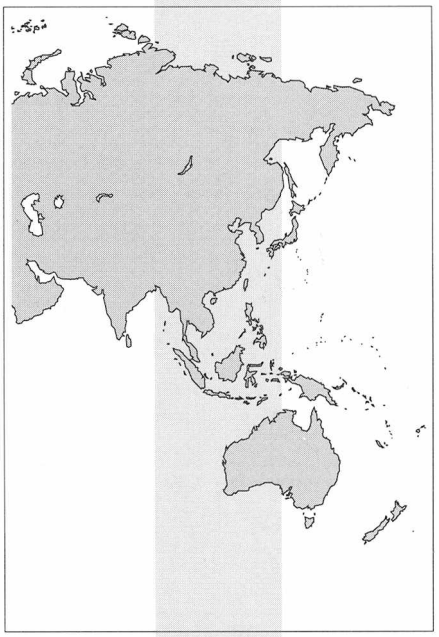
The association publishes an information bulletin and a technical journal, *Technical Acoustics*, in Russian. An English-language version of this journal is planned.

The Lithuanian Acoustical Society is associated with the EEAA, and agreements are being concluded with acoustical organizations in Bulgaria, Czechoslovakia, Hungary, Poland, Romania, and with the Federation of Acoustical Societies of Europe.

— *A. Nikiforov*, St. Petersburg.

Asia-Pacific News

A. Lawrence, *Asia-Pacific Editor*



JAPAN

INTER-NOISE 94 to be Held in Yokohama, Japan. INTER-NOISE 94, the 1994 International Congress on Noise Control Engineering, will be held at the PACIFICO YOKOHAMA (Pacific Convention Plaza Yokohama), Japan, from August 29 to 31, 1994. Technical papers in all areas of noise control engineering will be considered for presentation at the Congress and for publication in the Congress Proceedings. An Announcement and Call for Papers will be issued soon.

INTER-NOISE 94 will be the 23rd meeting of this annual event dating back to 1972. The Congress is sponsored by the International Institute of Noise Control Engineering (I/INCE), and is being organized jointly by the Institute of Noise Control Engineering of Japan and the Acoustical Society of Japan. Masaru Koyasu will serve as the Congress President, Toshio Sone will be the General Chairman, Sinichi Ohno and Hideki Tachibana will be responsible for the technical program, and Sonoko Kuwano will edit the Congress Proceedings.

A technical equipment exhibition will be held in conjunction with INTER-NOISE 94, and will include acoustical materials, measurement and calculation software, instruments, and equipment for active noise control. A short session will also be made available for presentations by exhibitors. The exhibition will be organized by Takahiko Ono and Kyoji Mugikura. An accompanying persons program and social activities for all delegates will be organized. Technical visits will also be arranged.

PACIFICO YOKOHAMA is located on Yokohama's magnificent waterfront overlooking the harbour, Bay Bridge and adjacent Seaside Park. PACIFICO YOKOHAMA is only a 10-minute bus ride from Yokohama station. Transportation between Narita Airport and Yokohama station is a comfortable 88-minute train ride on the Narita Express, or 90-minute limousine bus ride. INTER-NOISE 94 will be preceded by the 5th Western Pacific Regional Acoustics Conference in Seoul, Korea, from August 23 to 25, 1994 (Secretariat telephone: +82-2-361-2783, FAX: +82-2-365-4668). For more information, contact the INTER-NOISE 94 Congress Secretariat, Sone Lab. R.I.E.C., Tohoku University, 2-1-1 Katahira, Aoba-Ku, Sendai, 980 Japan. Fax: +81-22-263-9848, +81-22- 224-7889, email: in94@riec.tohoku.ac.jp.

AUSTRALIA & NEW ZEALAND

An Active Cooperation Agreement has been signed between Standards Australia and Standards New Zealand with the intent to make the publication of joint Australian/New Zealand standards the rule rather than the exception. All technical work will be supervised by three joint technical policy boards in the areas of Building, Electrotechnology, and Multitechnics. Where possible, joint standards will be prepared by joint committees comprising representatives from both countries. The Standards Australia policy of endorsing ISO and IEC standards, with as little alteration as possible, is continuing.

Standards New Zealand has published three updated standards: NZS6801, "Measurement of sound," NZS6802, "Assessment of environmental sound," and NZS6805, "Airport noise management and land use planning." The combined effect of these new standards is that environmental noise is now able to be more effectively measured and assessed. Better quality information is able to be provided to decision-makers. Environmental law in New Zealand has been enhanced in recent years, and this has lead to rigorous requirements for environmental impact assessments prior to local and regional government approval of development plans.

Pan American News

G.C. Maling, Jr., *Pan American Editor*

USA

NOISE-CON 93 to be Held in Williamsburg, Virginia. More than 100 technical papers will be presented at NOISE-CON 93, the 1993 National Conference on Noise Control Engineering, to be held in Williamsburg, Virginia, USA on 1993 May 2-5. The venue is the Fort Magruder Inn and Conference Center.

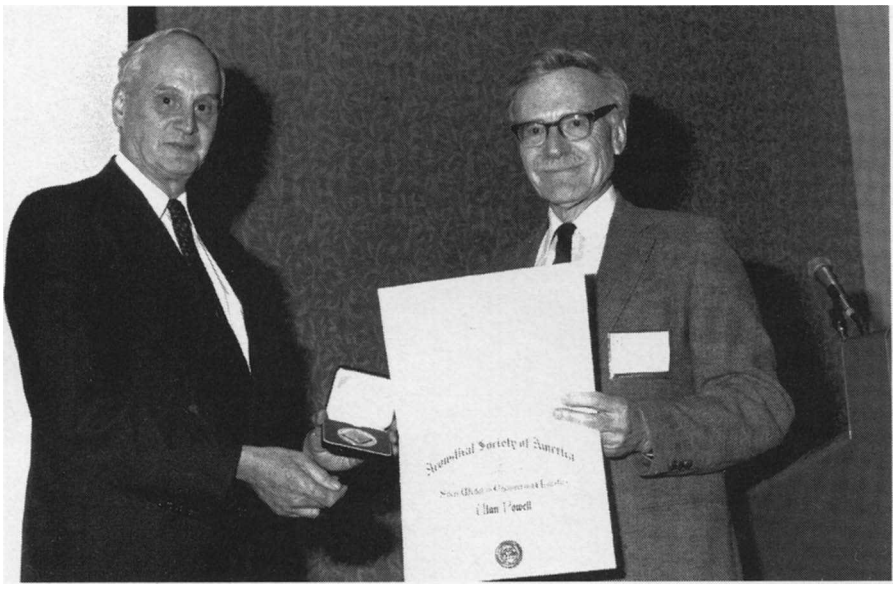
The conference is being co-sponsored by the NASA Langley Research Center and the Institute of Noise Control Engineering(INCE/USA). David G. Stephens of the NASA Langley Research Center is the General Chairman. Kevin P. Shephard is the Technical Program Chairman, and Harvey H. Hubbard will edit the conference proceedings.

Sessions at the conference will include special sessions on fan noise control, aircraft noise monitoring, and applications of active noise and vibration control. A listing of the papers accepted for presentation at NOISE-CON 93 as well as registration and hotel information was published in the 1992 November-December issue of *Noise/News*. An announcement is also available from the Conference Secretariat.

Conference attendees will have an opportunity to tour the NASA Langley Research Center. Dinner and a tour of the Virginia Air and Space Center in Norfolk, Virginia are also on the program. Special plenary session lectures will be given by an astronaut, Dr. Linda Godwin, as well as by Dr. John Ollerhead of the Civil Aviation Authority in the U.K. and Alan Mortlock from Douglas Aircraft.

A major exhibition of instruments and products for noise control will also be held at NOISE-CON 93. Philip G. Swartz will manage the exhibition. He may be contacted at 26 Vassar View Road, Poughkeepsie, NY 12603, USA. Telephone: +1 (914) 462-7733, FAX: +1 (914) 473-9325.

Further information on NOISE-CON 93 may be obtained from the Conference Secretariat, c/o David G. Stephens, MS462, NASA Langley Research Center, Hampton, VA 23681-0001. Telephone: +1 (804) 864-3640. FAX: +1 (804) 864-7687.



Alan Powell (left) receives the Silver Medal in Engineering Acoustics from ASA President Herman Medwin.

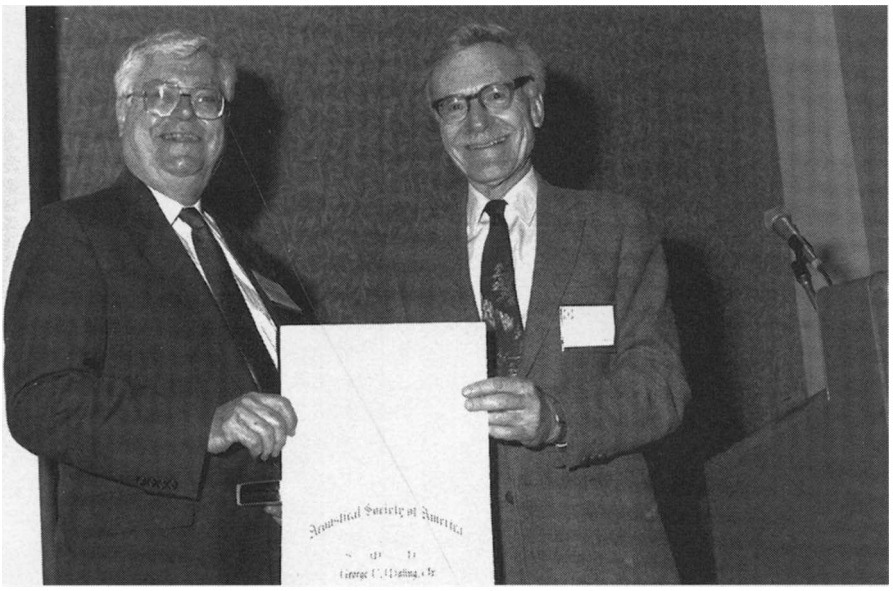
ASA Meets in New Orleans. The 124th meeting of the Acoustical Society of America was held in New Orleans, Louisiana, USA on 1992 October 31 - November 4. Several sessions were devoted to various aspects of noise control and physical acoustics, and will be of interest to readers of *Noise/News International*.

The Technical Committees on Noise and Physical Acoustics jointly sponsored a session on sonic booms. An overview paper was presented by Domenic J. Maglieri, the NASA high-speed research program was reviewed, and several papers were devoted to the physical and psychological aspects of sonic boom propagation. Several technical sessions were also devoted to the physical aspects of sound propagation outdoors and modeling for noise control, and an additional session was devoted to noise control for offshore platforms.

The ASA Technical Committee on Noise sponsored a session on "ASA's Role in Noise and its Control" on Monday, November 2. A series of papers was presented that covered the role that the Society has played in the control of noise, the current status of noise control in the federal government in the United States, state programs in noise control, education in noise control, plant noise control, and noise control in product design. The purpose of the session was to set the stage for more activity on noise control within the Society, and to encourage the development of noise control programs within the federal government.

At a Plenary session on November 2, the Society awarded Silver Medals in several technical areas of acoustics. Two recipients are members of both ASA and INCE/USA. The Silver Medal in Engineering Acoustics was presented to Alan Powell. Powell was educated in the United Kingdom, and has served in several posts in the United States, most recently as Professor of Mechanical Engineering at the University of Houston, Texas, USA. He is a past vice president of INCE/USA. He was cited *...for leadership in research in the silencing of ship noise and for fundamental contributions to aeroacoustics.*

The Silver Medal in Noise was awarded to George Maling. A graduate of Bowdoin College and the Massachusetts



George Maling (left) receives the Silver Medal in Noise from ASA President Herman Medwin.

Institute of Technology, he was a staff member at the IBM Acoustics Laboratory from 1965 to 1992, and has been active in the affairs of INCE/USA and International INCE for many years. He currently serves as Managing Editor of this publication. He was cited ... *for outstanding leadership in noise control and in the development of widely used, internationally and nationally standardized methods for noise evaluations.*

ASA announces new standards documents. The Acoustical Society of America has announced the availability of a new Draft American National Standard, Evaluating the Effectiveness of Hearing Conservation Programs. The new standard is designated Draft ANSI S12.13-1991 (ASA Catalog No. 97-1991).

This set of guidelines defines methods for evaluating the effectiveness of hearing conservation programs in preventing occupational noise-induced hearing loss by using techniques for audiometric database analysis. The rationale is given for using the data from annual monitoring audiograms as the basis for judging effectiveness. Guidelines are discussed concerning how to select a restricted database to which the analysis procedures will be applied. Specific procedures for data analysis are defined, and criterion ranges are given for classifying program effectiveness as acceptable, marginal, or unacceptable. Sample results for industrial audiometric databases contributed to Working Group S12/WG12 are included as an appendix for reference and illustration.

This draft standard is available from the Acoustical Society of America for USD 44; contact ASA, 335 E. 45th St., New York, NY 10017, USA.

The ASA has also announced the availability of a new American National Standard, Maximum Permissible Ambient Noise Levels for Audiometric Test Rooms. The new standard is designated ANSI S3.1-1991 (ASA Catalog No. 99-1991).

This standard specifies maximum permissible ambient noise sound pressure levels allowed in an audiometric test room that would produce negligible masking (dB) of test signals presented at reference equivalent threshold levels specified in American National Standard S3.6-1989. The maximum permissible ambient noise levels are specified for octave and one-third octave band intervals from 125 to 8000 Hz for two audiometric testing conditions (ears covered and ears not covered) and for three test frequency ranges (125 to 8000 Hz, 250 to 8000 Hz, and 500 to 8000 Hz). This standard is intended for use by all persons testing hearing and for distributors, installers, designers, and manufacturers of audiometric test rooms.

The standard is available from the Acoustical Society of America for USD 36; contact ASA, 335 E. 45th Street, New York, NY 10017, USA.

ASHRAE Revises Sound and Vibration Information. A revised sound and vibration control chapter has recently been published in the 1991 American Society of Heating Refrigerating and Air Conditioning Engineers (ASHRAE) HVAC Applications handbook. There have been some additions and changes to this chapter which may be of interest to engineers and acousticians. Among the new or revised sections are:

- Acoustical design criteria (room criteria (RC) curves are the preferred method of rating noise levels).

- Prediction fan sound power (the specific sound power levels for fans have been increased. This change should result in predicted fan sound power levels that are in better agreement with most manufacturer's AMCA-300 laboratory tests for sound power level).

- Noise control along duct paths (data for attenuation in unlined round ducts has been included).

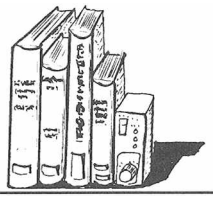
- An introduction to active sound attenuators is included.

- Rooftop curb-mounted air handlers (this is an entirely new section, and includes a discussion of several methods of dealing with duct breakout noise).

- An entirely new Chapter (49) entitled "Seismic Restraint Design" has been added. This covers the design of restraints for HVAC equipment in geographic areas subject to earthquakes.

For further information or copies of the ASHRAE Applications handbook, contact ASHRAE at 1791 Tullie Circle NE, Atlanta, GA 30329, USA. Telephone: +1 (404) 636-8400, FAX: +1 (404) 321-5478.

Book Reviews



Noise and Vibration Control Engineering
Leo L. Beranek and István L. Vér, Editors
John Wiley and Sons, Inc., 605 Third Avenue, New York, NY 10158
x + 804 pp., cloth, USD 89.95
In 1971, Leo L. Beranek edited his now classic volume, Noise and Vibration Control, a text very widely used in noise control. A revised edition of the book was prepared in 1988 and was published by the Institute of Noise Control Engineering of the United States (INCE/USA). In the revision, the chapter on criteria for noise control was completely revised, and the chapter on determination of the sound power level of sound sources was updated.

This book has a name similar to the 1971 classic, but it has been completely rewritten, many new authors have joined the editorial staff, and a wealth of new material has been added. The 21 chapters cover all aspects of noise control engineering, from the basics of sound propagation, to active noise control. The chapter headings give an indication of the scope of this text: Basic Acoustical Quantities: Levels and Decibels, Waves and Impedances, Data Analysis, Determination of Sound Power Levels and Directivity of Noise Sources, Outdoor Sound Propagation, Sound in Small Enclosures, Noise in Rooms, Sound-absorbing Materials and Sound Absorbers, Interaction of Sound Waves with Solid Structures, Passive Silencers and Lined Ducts, Vibration Isolation, Structural Damping, Enclosures and Wrappings, Noise of Gas Flows, Active Noise Control, Damage Risk Criteria for Hearing and Human Body Vibration, Criteria for Noise and Vibration in Communities, Buildings, and Vehicles, Prediction of Machinery Noise, Noise and Vibration Control of the Internal Combustion Reciprocating Engine, Noise and Vibration of Electrical Machinery, and Elements of Gear Noise Prediction.

This text would be very useful for a graduate course in noise control engineering, and will be invaluable for engineers, consultants, researchers, and others working in noise control. It provides a comprehensive overview of the technology of noise and vibration control engineering, and will in the future certainly become a classic English-language text in this field.

Elsevier's Dictionary of Noise and Noise Control
Robert Serré, Editor
Elsevier Science Publishers B.V., Sara Burgerhartstraat 25,
P.O. Box 211, 1000 AE Amsterdam, The Netherlands
iv + 206 pp., cloth, NLG 195.00
This dictionary includes definitions in the English language of 1175 keywords used in noise and noise control. In addition, there is a large number of cross-references to the keywords. For example, if one searches for a definition of "solid-borne sound," one is referred to the keyword "structure-borne sound." The French and German equivalents are given for each of the keywords. This trilingual dictionary is intended to be useful for scientists and engineers, health and safety professionals, labor and management representatives, indeed for anyone who is professionally concerned with noise and its control. It includes noise terms that are used in a number of diverse disciplines, including audiometry, psychological and physiological acoustics, standardization, architecture and urban planning, industrial safety, building and construction.

The dictionary includes many useful features, including synonyms and spelling variants, bibliographic sources, a separate listing of acronyms and abbreviations, and French and German indexes. It attempts to bring some degree of order and coherence to a multitude of terms and expressions from a broad spectrum of scientific, technical and medical disciplines.

Noise and Vibration of Electrical Machines
P.L. Timar, Editor
Elsevier Science Publishers B.V., Sara Burgerhartstraat 25,
P.O. Box 211, 1000 AE Amsterdam, The Netherlands
xvi + 339 pp., NLG 265.00, 1989
Originally published in the Hungarian language, and now available in English, the 18 chapters of this book are divided into three main topics: the generation and elimination of noise and vibration, experimental investigations of noise and vibration phenomena, and practical applications of vibroacoustic methods in the testing of rotating electrical machines. This is a systematic study summarizing currently-available knowledge of the vibroacoustic effects accompanying the energy conversion of electrical machines. This book deals with the acoustics of electrical machines in detail, presenting both the theoretical and the practical aspects of the generation of mechanical and magnetic noise by electrical machines. Beginning with a detailed field analysis used in the computation of the noise of electromagnetic origin in rotating electrical machines, the authors discuss the noise of inverter-fed asynchronous motors and the influence of loading. The book then deals with the noise of transformers and high voltage power lines. The second part of the book is devoted to vibroacoustical measurements. In addition to steady-state noise level data, the authors present practical analog and digital methods for measuring the noise characteristics of the machines in transient modes of operation and when generating impulsive sounds. This book is useful for engineers, designers, students and others who are concerned with the noise and vibration control of electrical machines.

Product News

Brüel & Kjær has announced its "Jubilee Releases" in celebration of its 50th year of service to the noise control and acoustics community

The new releases are highlighted in a brochure which is available from the company.

Added to the traditional acoustical and vibration product line are the Type 3550 Multichannel Analysis System, the Type 2144 Portable Frequency Analyzer, the Type 2012 Audio Analyzer, and the Type 4206 Two-Microphone Impedance Tube.

New instruments added to other product lines include the Type 3540 COMPASS System, an advanced vibration monitoring system for condition-based maintenance programs on industrial machinery, the Type 3538 Modular Test System, a VXIbus-based test and measurement system, and the Type 3535 Diagnostic Ultrasound System, a full-body diagnostic ultrasound system.

Brüel & Kjær has offices around the world. Readers may contact the company headquarters in Nærum, Denmark, or may use the reader service number that follows. **Circle Reader Service Number 50**

IAC Introduces Compartmented Anechoic Chamber

A compartmented Anechoic Chamber providing a calibrated acoustical environment for accurately determining simultaneously the sound characteristics of up to four small or miniature items of electronic or mechanical instrumentation or equipment is now available from Industrial Acoustics Company.

IAC offers this new multi-compartment model to assist in developing or refining the design and performance qualities of instrumentation or equipment such as disc drives for computers; timers; electric motors; fans; audio/video devices; household appliances or any finished products or components whose evaluation in an echo-free acoustical environment does not call for a walk-in Anechoic Chamber.

Weighing 7271 g, this portable chamber is fabricated of 102mm thick, all-steel, incombustible elements. Compartments 500mm x 500mm x 500mm with foam wedges feature a low-end cut-off frequency of 300 Hz with a 40-dB noise reduction between sections. Outside to inside noise reduction is rated at 45 dB.

For further information, contact Industrial Acoustics Company, Inc., 1160 Commerce Avenue, Bronx, NY 10462, USA. **Circle Reader Service Number 51**

Ono Sokki Introduces New Sound Level Meters

The new Ono Sokki sound level meters are said to provide a variety of functions, such as sound pressure level, A-weighted sound pressure level, equivalent continuous sound pressure level, A-weighted sound exposure level and percentile sound pressure level. The new model features a large LCD digital display along with a quasi-analog bar indicator.

Ono Sokki has also introduced a CF-4200 Series of FFT analyzers. CF-4200 analyzers are multi-purpose FFT analyzers said to be capable of quantifying noise and vibration data and providing GO/NO GO test results in a production environment. Test setups are stored in internal memory so the instrument is initialized when the operator turns it on. Data capture and comparison against a "good" reference may be initiated from the front panel or remotely via a set of contacts provided on the rear of the instrument.

For additional information, contact Mike Dixon, Ono Sokki Technology, Inc., 2171 Executive Drive, Suite 400, Addison, IL 60101, USA. **Circle Reader Service Number 52**

Scantek Announces New Real Time Analyzer, Microphones, and a Preamplifier

Scantek, Inc., has announced the availability of a two-page color brochure introducing the new Norsonic Type 840 Single- or Dual-channel Real-Time Analyzer. The Type 840 is said to be a true laboratory grade instrument in a compact package. This new portable and sophisticated unit is said to provide Type 1 specifications, 80 dB dynamic range, frequency analysis range of 1Hz to 20Hz in both channels, a large easy-to-read screen, true 1/3rd- and 1/1-octave analysis, storage for 10,000 spectra, DOS 3-1/2" floppy drive, a 1ms sample rate/spectrum, external VGA output, and selectable polarizing voltages. Soon to be included will be an internal signal noise generator, reverberation time calculations, internal 386 computer with full-size keyboard, 1/12- and 1/24-octave filters, user defined graphics, sound intensity, and FFT analysis.

Scantek has also announced the new Norsonic Type 1230 1/2" pressure microphones. The precision, Type 1, stable and linear microphone is meant for random and grazing-incidence measurements, especially for sound measurements in reverberation rooms. The Type 1230 is complementary to the Norsonic Type 1220 free-field (normal-incidence) microphones, also available from Scantek, Inc. Both microphones are compatible with most popular preamplifiers.

Also announced are Type 1201 microphone preamplifiers that can drive long cables with a virtually linear frequency response. For example, for a 32 m microphone cable and a Type 1201, the frequency response is said to be essentially flat from 2 Hz to 20 kHz.

For further information, contact Richard J. Peppin, President, Scantek, Inc., 916 Gist Avenue, Silver Spring, MD 20910, USA. Telephone: +1 (301) 495-7738. **Circle Reader Service Number 53**

Ford Motor Company to License Digisonix Technology

Nelson Industries, Inc., Wisconsin, USA, has granted the Ford Motor Company a non-exclusive, worldwide license to use Nelson's Digisonix active sound and vibration control technology on Ford passenger cars and light trucks.

Nelson and Ford currently are engaged in the third year of a development project related to the application of active sound and vibration control to passenger cars and light trucks. The work is being done at the Eriksson-Geddes Development Center in Madison, Wisconsin. Under the agreement, Ford will pay royalties for active sound and vibration control systems that are developed or produced using any Nelson technology.

Digisonix has also moved to a new office, manufacturing, and test facility. The increase in test and lab space includes a mechanical equipment room for complete mock-up of commercial heating, ventilating and air conditioning (HVAC) applications. This is useful for demonstrations as well as project performance guarantees.

Digisonix manufactures active noise control systems for HVAC air handling units, industrial air moving devices and a variety of other applications. Their system consists of a digital controller, two or more microphones to measure the undesired noise and one or more loudspeaker modules to generate the cancelling wave. In HVAC applications Digisonix Digital Sound Cancellation Systems are said to provide up to 15 dB reduction of the low-frequency "rumble" often generated by air handling units. On industrial fans, annoying pure tones are said to be reduced by up to 30 dB, which should solve most property line noise problems.

For further information contact Susan Dineen, DIGISONIX, 8401 Murphy Drive, Middleton, WI 53562, USA. **Circle Reader Service Number 54**

NCT Patents Electronic Muffler

Noise Cancellation Technologies, Inc. (NCT), has been awarded a US patent for its electronic muffler. Patent No. 5,097,923, awarded on March 24, 1992, covers technology developed by NCT to reduce unwanted noise produced by exhaust systems in automobiles, trucks, boats, buses, off-highway vehicles, and stationary engines using active noise control.

In addition, the muffler, which is said to be compact and economical to manufacture, can respond to varying levels of noise generated by exhaust systems during the acceleration and deceleration of normal driving. For more information contact: Irene Lebovics, Noise Cancellation Technologies, Inc., 800 Summer Street, Stamford, CT 06901-1023, USA. **Circle Reader Service Number 55**

Lord Introduces A New Software Product

A new software program called Sineware™ is said to simplify the selection of isolators for vibration, shock and motion control. Recently developed by the Industrial Products Division of Lord Corporation, the program is said to provide a step-by-step guide through the precise calculations necessary to determine which type of isolator to use for a particular vibration control problem.

"Engineers can now choose vibration isolators with a high degree of confidence," according to Jim Fraser, Business Unit Manager at the Industrial Products Division of Lord Corporation. "The program works in three dimensions and allows both rotational and translational vibration in all directions, so that all modes of vibration are analyzed. The program also ranks the recommended parts in the order of best isolation at a given frequency and lists a price index which can be used when several mount combinations are found to have the same isolation performance."

There are two versions of the Sineware program. Sineware Expert is an engine mount selector program, while Sineware Plus covers all other vibration control applications.

Both programs are available from the Industrial Products Division of Lord Corporation. To order or obtain additional information, write to the Lord Corporation, Industrial Products Division, 1952 West Grandview Blvd., Erie, PA 16514-0040, USA. Attention: Communications Dept. (Software). **Circle Reader Service Number 56**

GenRad Releases Software Package

GenRad, Inc., has announced the release of GR2530 SHOCK, transient vibration control test software package, which runs on the GR2530 Vibration Control and Analysis System. SHOCK complements the GR2530 RANDOM and SINE software packages to provide a complete solution for both quality assurance and engineering evaluation requirements. SHOCK is said to be particularly useful for simulation of vibration occurring from transportation and product handling.

SHOCK simplifies testing by offering what is said to be an easy-to-use operator interface, pulse library, and test automation features that reduce the time and effort required to set up and run a test. SHOCK's single keystroke menu operation, screen editor entry modes, and color-coded soft keys are said to make it easy to set up and run tests. The pulse library includes classical shock waveforms such as half-sine, terminal peak sawtooth, initial peak sawtooth, trapezoidal and rectangular pulse shapes. It requires minimal input to program a reference pulse, by simply specifying the pulse type, peak acceleration, and duration.

Supporting up to 16 simultaneous channels, SHOCK offers concurrent measurement and data retention, allowing real-time monitoring capability. When the test is finished, there is no waiting for off-line data reduction to test analysis can proceed instantly. The GR2530 SHOCK software sells for USD 6,985.

For further information, contact Dave Galyardt, Product Marketing Manager, GenRad, Inc., 510 Cottonwood Drive, Milpitas, CA 95035, USA. **Circle Reader Service Number 57**

Scantek Introduces Signs for High Sound Levels

Scantek, Inc., has announced the availability of two dynamic warning devices for areas with potentially high sound levels.

ENTERTAINMENT NOISE: The *Electronic Orange* is designed for control of amplified entertainment noise by the

cut-off principle. If the sound level exceeds a preset, but adjustable level, warning lights will flash to alert the operator. If the warning lights remain on for a given time, the power to the amplification equipment is cut off. After a suitable time the power returns automatically or manually. The *Electronic Orange* is said to be installable by a competent electrician.

INDUSTRIAL NOISE: The second product, the "Noise Activated Warning Sign" alerts people when noise exceeds a preset, but adjustable level. Since many workers do not like to wear personal hearing protection, the use of this unit allows workers to remain comfortable until levels are excessive. The screen is blank until activated. The sign nominally says *Approved Hearing Protection Must be Worn* but can be ordered with different messages in a variety of colors. The sign provides a sensible and simple way to enforce some provisions of a good industrial noise program.

For further information, contact Richard J. Peppin, President, Scantek, Inc., 916 Gist Ave., Silver Spring, MD 20910, USA. **Circle Reader Service Number 58**

Overly Introduces Sound-Retardant Wood Door System

Overly Manufacturing Co. has introduced a wood door to its line of sound-retardant door systems. The new Overly Wood Door is said to have an STC 46 rating and to have been tested to the latest American Society for Testing and Materials (ASTM) E90-90 standards.

The sound-retardant wood door system is factory prepared for standard builders hardware, and includes the flush door, hollow metal frame, cam-lift hinges and seals. The Overly split frame construction is also available. For more information on the new Overly Sound-Retardant Wood Door, contact John Brooks, Overly Manufacturing Co., P.O. Box 70, Greensburg, PA 15601, USA. **Circle Reader Service Number 59**

Milco Offers Window Brochure

Larger window details and a new, easy-to-reference specifications chart for custom aluminum windows are featured in an updated brochure from Milco, a division of the Apogee Wausau Group. The brochure is also included in the sound control windows section of the 1992 Sweets Catalog File. Milco acoustical windows are said to be ideal for soundproofing noise-sensitive structures such as schools, hospitals, nursing homes, offices, airports and transportation terminals.

Milco produces a complete line of acoustical 4-track windows including horizontal rolling, double hung, fixed and fixed removable windows with Sound Transmission Class (STC) ratings as high as 54.

For more information contact Jim Daniels, Acoustical Product Consultant, Milco, P.O. Box 1366, 7555 Stewart Avenue, Wausau, WI 54402-1366, USA. **Circle Reader Service Number 60**

Sound Power Determination Class—Using Sound Intensity

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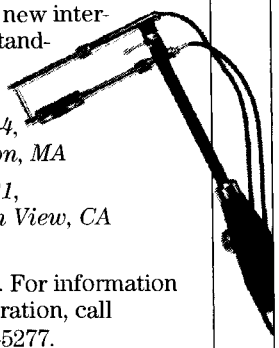

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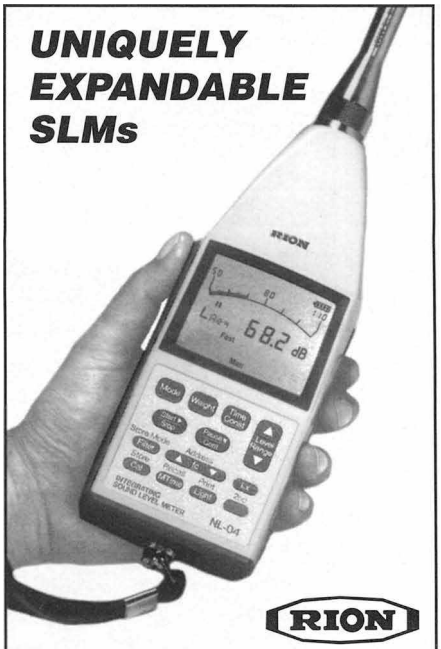

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Conference Calendar

Organizations interested in having a conference related to noise and vibration should send information to Conference Calendar, INCE/USA, P.O. Box 3206 Arlington Branch, Poughkeepsie, NY 12603, USA. FAX +1 (914) 473-9325

1993 March 31-April 2
XXI National Congress of the Italian Acoustical Association, Italy. Contact: Alessandro Peretti, Via Siracusa 51, I 35100 Padova, Italy. Telephone: +39 49 693086, FAX: +39 49 693086

1993 April 21-23
ACOUSTICS 93, Annual Spring Conference of the Institute of Acoustics, Southampton, United Kingdom. Contact: Mrs. C.M. Mackenzie, Institute of Acoustics, P.O. Box 320, ST. ALBANS, Herts AL1 1PZ, United Kingdom. Telephone: +44 072748195, FAX: +44 072750553

1993 April 28-30
Second Conference on Recent Advances in Active Control of Sound and Vibration, Blacksburg, Virginia, USA. Contact: Dawn Williams, Mechanical Engineering Department, 205 Randolph Hall, VPI & SU, Blacksburg, VA 24061-0238, USA. Telephone: +1 (703) 231-4162, FAX: +1 (703) 231-9100.

1993 May 2-5
NOISE-CON 93, The 1993 National Conference on Noise Control Engineering, Williamsburg, Virginia, USA. Contact: NOISE-CON 93 Conference Secretariat, c/o David G. Stephens, MS462, NASA Langley Research Center, Hampton, VA 23681-0001, USA. Telephone: +1 (804) 864-3640, FAX: +1 (804) 864-7687.

1993 May 10-13
1993 SAE Noise and Vibration Conference & Exposition, Grand Traverse Resort, Travis City, Michigan, USA. Contact: Patricia Couhig, Specialty Conference Administrator, Society of Automotive Engineers, 400 Commonwealth Dr., Warrendale, PA 15096, USA. FAX: +1 (412) 776-0002.

1993 May 17-21
125th Meeting of the Acoustical Society of America, Ottawa, Ontario, Canada. Contact: Elaine Moran, Acoustical Society of America, 500 Sunnyside Blvd., Woodbury, NY 11797, USA. Telephone: +1 (516) 576-2360, FAX: +1 (516) 349-7669.

1993 May 31-June 3
NOISE 93, International Noise and Vibration Conference, St. Petersburg, Russia. Contact: Professor M.J. Crocker, Department of Mechanical Engineering, Auburn University, AL 36849, USA. Telephone: +1 (205) 844-3310, FAX: +1 (205) 844-3307.

1993 July 5-9
Noise & Man '93, 6th International Congress on Noise as a Public Health Problem, Nice, France. Contact: Noise & Man '93, Inrets Len, Case 24, 109 Avenue Salvador Allende, 69675 Bron Cedex, France. Telephone: +33 72 36 23 00, FAX: +33 72 37 68 37

1993 July 7-9
International Symposium on Pump Noise and Vibration, Paris, France. Contact: M. Perrin, SHF, 199, rue de Grenelle, 75007 PARIS, France. Telephone: +33 1 47 05 13 37, FAX: +33 1 45 56 97 46.

1993 August 24-26
INTER-NOISE 93, the 1993 International Congress on Noise Control Engineering, Leuven, Belgium. Contact: Congress Secretariat, Christine Mortelmans, TI-K VIV, Desguinlei 214, B-2018 Antwerpen, Belgium. Telephone: +32 3 216 0996, FAX: +32 3 216 06 89

1993 August 31-September 2
4th International Congress on Intensity Techniques: Structural Intensity and Vibrational Energy Flow, Senlis, France. Contact: Mrs. M. Canabate, CETIM, B.P. 67, SENLIS, France. Telephone: +33 44 58 34 15, FAX: +33 44 58 34 00

1993 September 2-3
Biennial Conference on the New Zealand Acoustical Society, Wellington, New Zealand. Contact: Malcolm Hunt, Secretary of the NZ Acoustical Society, Telephone: +64 4 384 6211, FAX: +64 4 384 3306.

1993 October 4-8
126th Meeting of the Acoustical Society of America, Denver, Colorado, USA. Contact: Elaine Moran, Acoustical Society of America, 500 Sunnyside Blvd., Woodbury, NY 11797, USA. Telephone: +1 (516) 576-2360, FAX: +1 (516) 349-7669.

1993 November 9-10
"Progress in acoustics, noise, and vibration control," Australian Acoustical Society annual conference, Glenelg, SA, Australia. Contact: AAS Annual Conference 1993, Dept. of Mechanical Engineering, University of Adelaide, GPO Box 498, Adelaide, SA 5001, Australia. FAX: +61 8 2240464.

1994 June 5-9
127th Meeting of the Acoustical Society of America, Cambridge, Massachusetts, USA. Contact: Elaine Moran, Acoustical Society of America, 500 Sunnyside Blvd., Woodbury, NY 11797, USA. Telephone: +1 (516) 576-2360, FAX: +1 (516) 349-7669.

1994 August 23-25
5th Western Pacific Regional Acoustics Conference, Seoul, Korea. Contact: Conference Secretariat. Telephone: +82 2 361-2783, FAX: +82 2 365-4668.

1994 August 29-31
INTER-NOISE 94, the 1994 International Congress on Noise Control Engineering, Yokohama, Japan. Contact: INTER-NOISE 94 Congress Secretariat, REIC, Tohoku University, 2-1-1 Katahira, Aoba-Ku, Sendai 980, Japan. Telephone: +81 22 224 7889, FAX: +81 22 263 9848.

1994 November 28-December 2
128th Meeting of the Acoustical Society of America, Austin, Texas, USA. Contact: Elaine Moran, Acoustical Society of America, 500 Sunnyside Blvd., Woodbury, NY 11797, USA. Telephone: +1 (516) 576-2360, FAX: +1 (516) 349-7669.

1995 May 31-June 4
129th Meeting of the Acoustical Society of America, Washington, DC, USA. Contact: Elaine Moran, Acoustical Society of America, 500 Sunnyside Blvd., Woodbury, NY 11797, USA. Telephone: +1 (516) 576-2360, FAX: +1 (516) 349-7669.

1995 July 10-12
INTER-NOISE 95, The 1995 International Congress on Noise Control Engineering, Newport Beach, California, USA. Contact: Institute of Noise Control Engineering, P.O. Box 3206 Arlington Branch, Poughkeepsie, NY 12603, USA. Telephone: +1 (914) 462-4006, FAX: +1 (914) 473-9325.

1995 November 27-December 1
130th Meeting of the Acoustical Society of America, St. Louis, Missouri, USA Contact: Elaine Moran, Acoustical Society of America, 500 Sunnyside Blvd., Woodbury, NY 11797, USA. Telephone: +1 (516) 576-2360, FAX: +1 (516) 349-7669.

1996 May 20-24
131st Meeting of the Acoustical Society of America, Ames, Iowa, USA. Contact: Elaine Moran, Acoustical Society of America, 500 Sunnyside Blvd., Woodbury, NY 11797, USA. Telephone: +1 (516) 576-2360, FAX: +1 (516) 349-7669.

1996 December 2-6
132nd Meeting of the Acoustical Society of America, Honolulu, Hawaii, USA. Contact: Elaine Moran, Acoustical Society of America, 500 Sunnyside Blvd., Woodbury, NY 11797, USA. Telephone: +1 (516) 576-2360, FAX: +1 (516) 349-7669.

INTER-NOISE 92 PROCEEDINGS NOW AVAILABLE

NOISE CONTROL AND THE PUBLIC was the theme of INTER-NOISE 92, the 1992 International Congress on Noise Control Engineering. INTER-NOISE 92 was sponsored by the International Institute of Noise Control Engineering (International INCE), and was organized by The Canadian Acoustical Association and the Institute of Noise Control Engineering of the USA. INTER-NOISE 92 was held in Toronto, Canada on 1992 July 20-22. The Proceedings of INTER-NOISE 92 are now available. The INTER-NOISE 92 Proceedings contain a total of two hundred and seventy papers.

Special sessions on a number of topics of current interest in noise control engineering were held at INTER-NOISE 92, and the papers from these sessions are included in the Proceedings. The topics covered in the special sessions include case studies of active noise control, air-moving device noise, state of the art criteria for noise control in buildings, road traffic noise prediction, measurement and calculation of aircraft noise, metrics for airport environmental noise, effects of noise: community reaction, automobile interior noise quality, computers in noise control, and international standards to meet European noise control requirements. NOISE CONTROL AND THE PUBLIC will be of interest to engineers concerned with noise control technology, educators, scientists, acoustical consultants, government researchers and regulators, architects, students, and others concerned with the control of environmental noise.

Enclosed is my check for USD _____. Please send me _____ copies of the INTER-NOISE 92 Proceedings at USD 125.00 each. The Proceedings is a set of two volumes; Vol. 1, xxxii + 636 technical pages, Vol. 2, xxxii + 628 technical pages. ISBN 0-931784-25-5 (set of two volumes). Sold only as a set of two volumes. Shipped postpaid except for overseas orders shipped by air.

SPECIAL INSTRUCTIONS FOR OVERSEAS ORDERS. Payment must be made in U.S. Funds, either through a U.S. bank or through a correspondent bank in the United States. Overseas orders must add USD45.00 extra for air mail postage and handling if shipment overseas is to be made by air.

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Poughkeepsie, NY 12603, USA

Standards News

Avril Brenig, Standards Manager
ASA Standards Secretariat, Acoustical Society of America,
335 East 45 Street, New York, New York 10017-3483

Ervin Gross
561 Montego Lane South, Ellenton, Florida 34222

American National Standards (ANSI Standards) developed by Accredited Standards Committees S1, S2, S3, and S12 in the areas of acoustics, mechanical shock and vibration, bioacoustics, and noise are published by the Acoustical Society of America (ASA) through the American Institute of Physics (AIP). In addition to these standards, other publications— Catalog of Acoustical Standards— ASA Catalog 11-1992; an Index to Noise Standards— ASA STDS Index 3-1985 (national and international); and a Directory of the Standards Program— ASA Standards Directory No. 2-1989— are available from the ASA Standards Secretariat. For a copy, write to Avril Brenig, at the above address, or telephone (212) 661-9404.

Calendar (for *Standards News*)

The next meetings of the Standards Committees are scheduled to be held during the Spring ASA Meeting at the Chateau Laurier Hotel, Ottawa, Canada, 17-21 May 1993.

- *Monday, 17 May 1993*

ASA Committee on Standards (ASACOS) at 3:30 p.m. Meeting of the Committee that directs the ASA Standards Program.

- *Wednesday, 19 May 1993*

Accredited Standards Committee S2 on Mechanical Shock and Vibration (also Technical Advisory Group for ISO/TC 108 Mechanical Vibration and Shock) at 9:00 a.m. Review of S2 and International Standards activities and planning for future meetings.

- *Thursday, 20 May 1993*

Accredited Standards Committee S12 on Noise (also Technical Advisory Group for ISO/TC 43/SC1— Noise and ISO/TC 94/SC 12— Hearing Protection) at 9:30 am. Review of S12 and International Standards activities and planning for future meetings.

- *Thursday, 20 May 1993*

Accredited Standards Committee S3 on Bioacoustics (also Technical Advisory Group for ISO/TC 43— Acoustics, IEC/TC 29— Electroacoustics, and ISO/TC 108/SC 4— Human Exposure to Mechanical Vibration and Shock) at 1:30 pm. Review of S3 and International Standards activities and planning for future meetings.

- *Thursday, 20 May 1993*

Accredited Standards Committee S1 on Acoustics (also Technical Advisory Group for ISO/TC 43— Acoustics and IEC/TC 29— Electroacoustics) at 3:00 pm. Review of S1 and International Standards activities and planning for future meetings.

Reprinted by permission from the Journal of The Acoustical Society of America, Volume 92, 1992 November.

Standards News from the USA

Newly published American National Standards

The new and revised standards listed here are now available from ANSI's Sales Department. Standards Action solicited comment on them and reported their subsequent approval as American National Standards by the Board of Standards Review. It now announces their availability. See the latest catalog of American National Standards for shipping/handling charges and discount information.

AUDIO SYSTEMS

ANSI S4.40-1992, Recommended Practice for Digital Audio Engineering— Serial Transmission Format for Two-Channel Linearly Represented Digital Audio Data, $18.00.

ANSI S4.48-1992, Professional Audio Equipment— Application of Connectors, Part 1, XLR-Type Polarity and Gender, $18.00.

BIOACOUSTICS

ANSI S3.1-1991, Maximum Permissible Ambient Noise Levels for Audiometric Test Rooms, $42.00.

NOISE

ANSI S12.12-1992, Engineering Method for Determination of Sound Power Level of Noise Sources using Sound Intensity (New Standard).

ACOUSTICS

ANSI S1.22-1992, Scales and Sizes for Frequency Characteristics and Polar Diagrams in Acoustics (New Standard).

The following item was submitted to Standards News by Robert W. Young, Chairman of S1/WG10 that prepared ANSI S1.22-1992 and nursed it from proposal to Draft Standard and finally to ANSI Approval and Publication.

Item for Standards News suggested by R. W. Young, 29 July 1992

American National Standard Scales and Sizes for Frequency Characteristics and Polar Diagrams in Acoustics, S1.22-1992, was approved by the American National Standards Institute on 7 February 1992. For rectangular Cartesian graphs in which a level (in decibels) of an acoustical quantity is plotted against frequency on a logarithmic scale, the scale proportions are those for which the length for a 10:1 frequency ratio on the abscissa is equal to the length for a level difference of 25, 50, or 10

decibels (dB) on the ordinate. The first proportion is most frequently used. For polar diagrams in which an absolute or relative level is shown increasing outward along a radius on a linear scale, a reference circle is identified whose radius is a difference in level of 50 dB or 25 dB. The preferred size for one decibel is 2,1, or 5 mm.

Need for a few standard scale proportions was recognized by International Electrotechnical Commission (IEC) Publication 263 (1967), particularly in connection with automatic and hand-plotting of sound spectra at 1/3-octave intervals. The second and third editions, IEC 263(1975) and IEC 263 (1982), added details primarily about polar plots.

Even though a decade later, the scales and sizes of ANSI S1.22-1992 are the same as in IEC 263 (1982). However, the height of lettering in S1.22-1992 is 1/40 to 1/50 the narrow dimension of a figure, rather than 1/70 as in IEC 263(1982), to yield transparencies or slides which, when projected, can easily be read from a typical viewing distance.

In 1967 it was feasible to tabulate 18 one-third-octave-band sound pressure levels centered, respectively, on 100 Hz to 5 kHz, and if necessary to replot them with the standardized scale proportions. But it is not feasible to tabulate or plot by hand the 400 or 800 "lines" now being made available by the fast Fourier transform. An efficient way to compare two such spectra quickly and quantitatively is to plot them automatically to the same standard scales and size, so the graphs can be superposed accurately. Even though the visual display of an analyzer is not in accordance with S1.22-1992, it is often feasible to send the output of the analyzer to a plotter which can be programmed to produce the standard scales and sizes.

Although R. W. Young is shown in the foreword of S1.22-1992 as the sole member of the working group that drafted the Standard, most of the words actually came from the working groups that prepared IEC 263 (1967, 1975, 1982).

Committee on Standards (ASACOS) 1992-1993
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Standards News from the United States— from ANSI Standards Action

Final Actions on American National Standards

BIOACOUSTICS
ANSI S3.42-1992, Testing Hearing Aids with a Broad Band Noise Signal (new standard)
Approval date: 2 June 1992

American National Standards— Call for comment on proposals listed

This section solicits your comments on proposed new American National Standards and on proposals to revise, reaffirm, or withdraw approval of existing American National Standards. Identification of any known or potential conflicts of draft standards listed with any existing standards may be included and would be appreciated. Comment is solicited to ensure that the views of all interested parties have been given full consideration. To be certain that no standards of interest are overlooked, please check all listings.

In your response, please specify whether you approve or disapprove of the proposal as an American National Standard. If you provide technical comments with your approval, indicate whether approval is contingent upon considering them for in-

clusions (1) in the current proposal of (2) in future revisions of the current proposal. If you disapprove, give your reasons.

Ordering Instructions for "Call-for-Comment" Listings

1. Order from the organization indicated for the specific proposal.
2. Use the full identification in your order, including the BSR prefix; for example, Electric Fuses BSR/SAE J554.
3. Include remittance with all orders.
4. Limit your order to BSR proposals. Submit a separate order for newly published standards.
5. BSR proposals will not be available after the deadline of call for comment.

Comments should be addressed to the organization indicated, with a copy to the Board of Standards Review, American National Standards Institute, 11 West 42nd Street, New York, NY 10036.

ACOUSTICS

BSR S3.4-1980, Procedure for the Computation of Loudness of Noise (reaffirmation of ANSI S3.4-1980). Single copy price: $28.00.

BSR S3.21-1978, Method for Manual Pure-Tone Threshold Audiometry (reaffirmation of ANSI S3.21-1978). Single copy price: $28.00.

BSR S3.34-1986, Guide for the Measurement and Evaluation of Human Exposure to Vibration Transmitted to the Hand (reaffirmation of ANSI S3.34-1986). Single copy price: $40.00.

BSR S3.37-1987, Preferred Earhook Nozzle Thread for Postauricular Hearing Aids (reaffirmation of ANSI S3.37-1987). Single copy price: $22.00.

Order from: American National Standards Institute
Attn: Sales Department
11 West 42nd Street, New York, NY 10036.

Send comments (with copy to BSR) to:
Acoustical Society of America
Attn. A. Brenig
335 East 45th Street, New York, NY 10017-3483

National Standards Week • 10-16 October 1993

National Standards Week paper competition

"Standards: A Strategic Investment": To highlight the importance of standards to industry and government, the sponsors of National Standards Week are holding a paper competition on the theme "Standards: A Strategic Investment." The paper should contribute to furthering the development and understanding of standardization in commerce, industry, and government. The content should have a practical basis, preferably from the writer's own experience.

Prize: The winner will receive a cash prize of $2500 and a special plaque, and the winning paper will be published in national publications. Runners-up will receive plaques and national recognition.

Eligibility: The competition is open to individuals in private sector or government facilities located in the United States. Employees of nationally recognized private sector standards developing organizations are ineligible.

Judging: Papers will be judged by three independent judges selected by the National Standards Week Committee.

Rules for Entry: Papers should be submitted in English. They must be original and not previously published. Papers should be between 2500 and 4500 words and should not exceed 20 pages. Deadline for entries is June 15, 1993. Contest rules and application forms may be obtained from the National Standards Week Paper Contest, Standards Engineering Society, P. 0. Box 2307, Dayton, Ohio 45401-2307; FAX: (513) 223-6307.

ANSI 1993 awards: Call for nominations

It is once again time to step back and recognize those unique individuals from the U.S. voluntary standards community who have demonstrated leadership and commitment to the national and international standardization process. Nominations are now being accepted. The 1993 recipients of ANSI's prestigious awards will be honored during the Board of Directors Awards Banquet to be held on 17 March 1993; the day preceding ANSI's 1993 Public Conference, which will take place 18-19 March in Washington, DC.

The six awards are:

Astin Polk International Standards Medal for distinguished service toward the advancement of international standardization;

Finegan Standards Medal for extraordinary leadership in the actual development and application of voluntary standards;

Howard Coonley Medal for outstanding service to the national economy through standardization;

George S. Wham Leadership Medal for outstanding contributions in providing direction and long range planning to the ANSI federation;

Edward Lohse Information Technology Medal for significant contribution to information technology standardization and leadership; and

Meritorious Service Award for significant contribution to voluntary standardization and ANSI.

Nominations must be received by **1 December 1992.** Send to: ANSI Board of Directors' Awards Committee, c/o ANSI, External Relations Department, 11 West 42nd Street, New York, NY 10036. Requests for additional information or nominations guidelines, should be faxed to **Suzanne Hurst** of ANSI staff at (212) 398-0023.

Standards News from Abroad

Newly published International Standards

Listed here are new and revised standards recently approved and promulgated by ISO— the International Organization for Standardization— and IEC— the International Electrotechnical Commission. They are all available from ANSI, the U.S. member of 150 and IEC and the sole source in the United States of their publications. Catalogs listing several thousand current ISO and IEC standards are also available from ANSI. Write or call the Sales Department for information.

IEC Standards

ELECTRO-ACOUSTICS (TC 29)

IEC 1094-1: 1992, Measurement microphones— Part I: Specifications for laboratory standard microphones, $36.00.

ISO and IEC Draft International Standards

This section lists proposed standards that the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC) are considering for approval. The proposals have received substantial support within the technical committees or subcommittees that developed them and are now being circulated to ISO and IEC members for comments and vote. *Standards Action* readers interested in reviewing and commenting on these documents should order copies from ANSI.

Comments

Comments should be sent to Gary W. Kushnier, Vice President, Standards Technology, at ANSI headquarters. The final date for offering comments is listed after each draft.

Ordering Instructions

1. Order from International Sales Department, American National Standards Institute, 11 West 42nd Street, New York, NY 10036.
2. Include in orders the titles and corresponding ISO and IEC Draft International Standard (DIS) numbers.
3. Send remittance with order.
4. Limit your order to ISO and IEC Draft Standards. Send separate orders for BSR proposals and newly published American National Standards and ISO and IEC Standards.

ISO Draft International Standards

ACOUSTICS (TC 43)

ISO/DIS 140-3, Acoustics— Measurement of sound insulation in buildings and of building elements— Part 3: Laboratory measurement of airborne sound insulation of building elements— 2 November 1992, $21.00.

MECHANICAL VIBRATION AND SHOCK (TC 108)

ISO/DIS 11342, Mechanical vibration— Methods and criteria for the mechanical balancing of flexible rotors (revision of ISO 5406: 1980 and ISO 5343: 1983)— 2 November 1992, $47.00.

International documents submitted to the U.S. for vote and comment July-August 1992

TAG	ISO Documents
S2,S3	*ISO/DIS 7196.2*— Acoustics— Frequency weighting characteristic for infrasound measurement
S12	*Second ISO/CD 11957*— Acoustics— Determination of sound insulation performance of cabins— Laboratory and *in situ* measurements
S12	*Third ISO/CD 11689*— Acoustics— Systematic collection and comparison of noise emission data for machinery and equipment
S3	*ISO/TC 43/SC1 N 838:* ISO/CD 226-1— Acoustics— Equal-loudness level contour for otologically normal listeners. Part 1: Reference threshold of hearing under free-field and diffuse-field listening conditions
S3	*Second ISO/CD 8253-3*— Acoustics— Audiometric test methods. Part 3: Speech audiometry

TAG	IEC Documents
S3,S1	*IEC/TC 29 (Secretariat) 239*— IEC 645.4: Audiometers. Part 4: Equipment for extended high frequency audiometry

World Standards Day • 14 October 1992

While it is too late to react this year, mark your calendar for 1993. The World Standards Day celebration is held annually on 14 October to provide recognition to thousands of standards professionals who volunteer their time to advance international standardization. The International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC), sponsors of the event, have announced the theme of this year's commemorative day will be "International Standards— A Key to Open Markets."

In selecting this theme, ISO and IEC give recognition to the growing importance international standards are having on the free movement of goods and services across national frontiers. They contribute to the free movement of these products and services around the world. Never has it been so clear that the "Global Village" has arrived and one of the keys to that community is international standards.

Nobody knows this better than business and government, where international standards are suddenly being seen as a way to success in a changed world. Standards are no longer perceived as "add ons" to finished products and services, but instead are built-in to the manufacturing, processing and service industries.

International Standardization Information

The latest catalogs of standards from the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC) are now available from the Institute's Customer Service Department. Tel: (212) 642-4900.

These publications are a must for standards professionals needing information on the latest published standards from the world's leading international standardization bodies. The purchase price for these publications are: *ISO Catalog,* $50; *IEC Catalog,* $30. The Institute is also making available the *ISO Technical Program* ($30) and the *IEC Yearbook* ($90), both of which provide information on draft international standards. Other ISO publications available from ANSI include the *ISO Memento* ($42), which provides information on the ISO organization and structure, and the *ISO Bulletin* ($50 annual subscription), a monthly publication reporting on the activities of ISO. Also available is the *IEC Bulletin* ($40 annual subscription), a bimonthly publication reporting on the activities of IEC.

In an effort to keep its members abreast of the latest standards activities within standards bodies around the world, ANSI also makes available standards catalogs from the *European Committee for Standardization* (CEN) and the *European Committee for Electrotechnical Standardization* (CENELEC) and approximately 50 ISO member bodies. Standards catalogs from the organizations of AFNOR in France, DIN in Germany, and JISG in Japan are just a few of the national publications available from the Institute.

NNI DIRECTORY

ACKNOWLEDGEMENTS

The Board of Directors of INCE/USA expresses its appreciation to the Acoustical Society of America for its support and cooperation in the publication of *Noise/News* since its inception in 1972. The Board also gratefully acknowledges the financial assistance being given by the members of the INCE/USA Liaison Program:

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FAN NOISE PROCEEDINGS ARE AVAILABLE

Jean Tourret, General Secretary, opened the International INCE Fan Noise Symposium on 1992 September 1. The Symposium, devoted to noise from fans, was held at the Centre Technique des Industries Méchanique (CETIM) in Senlis, France on 1992 September 1-3. The event attracted more than 250 attendees - a large number for a symposium on a specialized topic. Fifty-three papers on the noise of axial and centrifugal fans were presented during the three-day symposium, and appear in the symposium proceedings.

Four plenary session lectures were given during the symposium. William Corey, Woods of Colchester, Colchester, U.K., gave a very interesting opening lecture on the history of ventilating fans and techniques for measurement of noise emission. His presentation was devoted mainly to the noise of large fans used in industry.

Wolfgang Neise, DLR-Abteilung Turbulenzforschung Berlin, Germany gave a comprehensive presentation of mechanisms for noise generation in fans, and discussed measurement methods for determination of sound power.

George Maling presented a state-of-the-art review of noise emission by small air-moving devices. A brief history of fan noise studies in the United States was given, measurement methods were reviewed, and directions for future research were identified.

A.N. Bolton of NEL in Glasgow, U.K. presented a paper on the effects on noise emission due to the installation of fans, that is, changes in noise emission under actual operating conditions as opposed to noise emission under standardized test conditions. He emphasized mainly installation effects for large-diameter units.

In addition to these plenary lectures, fifty invited and contributed papers appear in the Proceedings of the symposium. These papers represent the current state of the technology of air-moving device noise control, and are devoted to basic studies of axial fan noise, noise control in axial and mixed-flow fans, basic studies on centrifugal and cross-flow fans, noise control in centrifugal fans, prediction and similarity laws, system effects, measurement of airborne noise (including noise in ducts), measurement of structureborne noise, and ducts and silencers for fan noise control.

A limited number of the Proceedings of this CETIM fan noise symposium are available. A coupon is provided for those who wish to order this volume.

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The theme of the 1993 INCE Seminar will be *Noise Control of Air-Moving Devices.* Opportunity will be given during the 2-day seminar for informal discussions on topics of special interest to the attendees.

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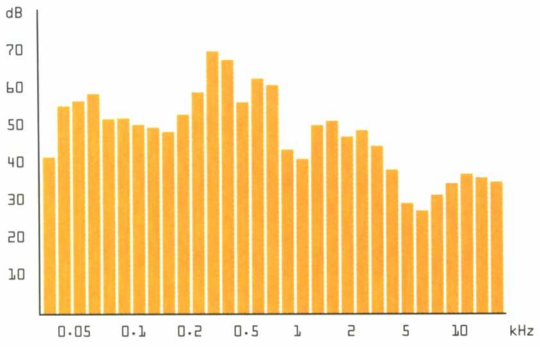

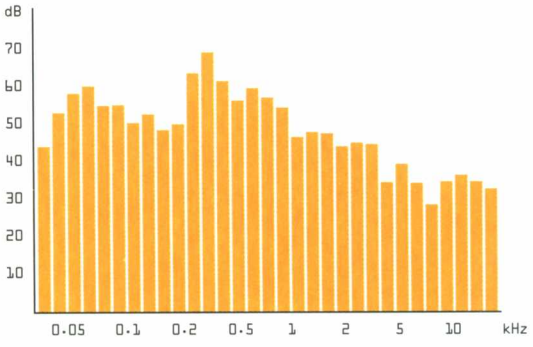

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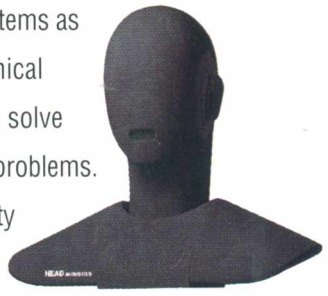

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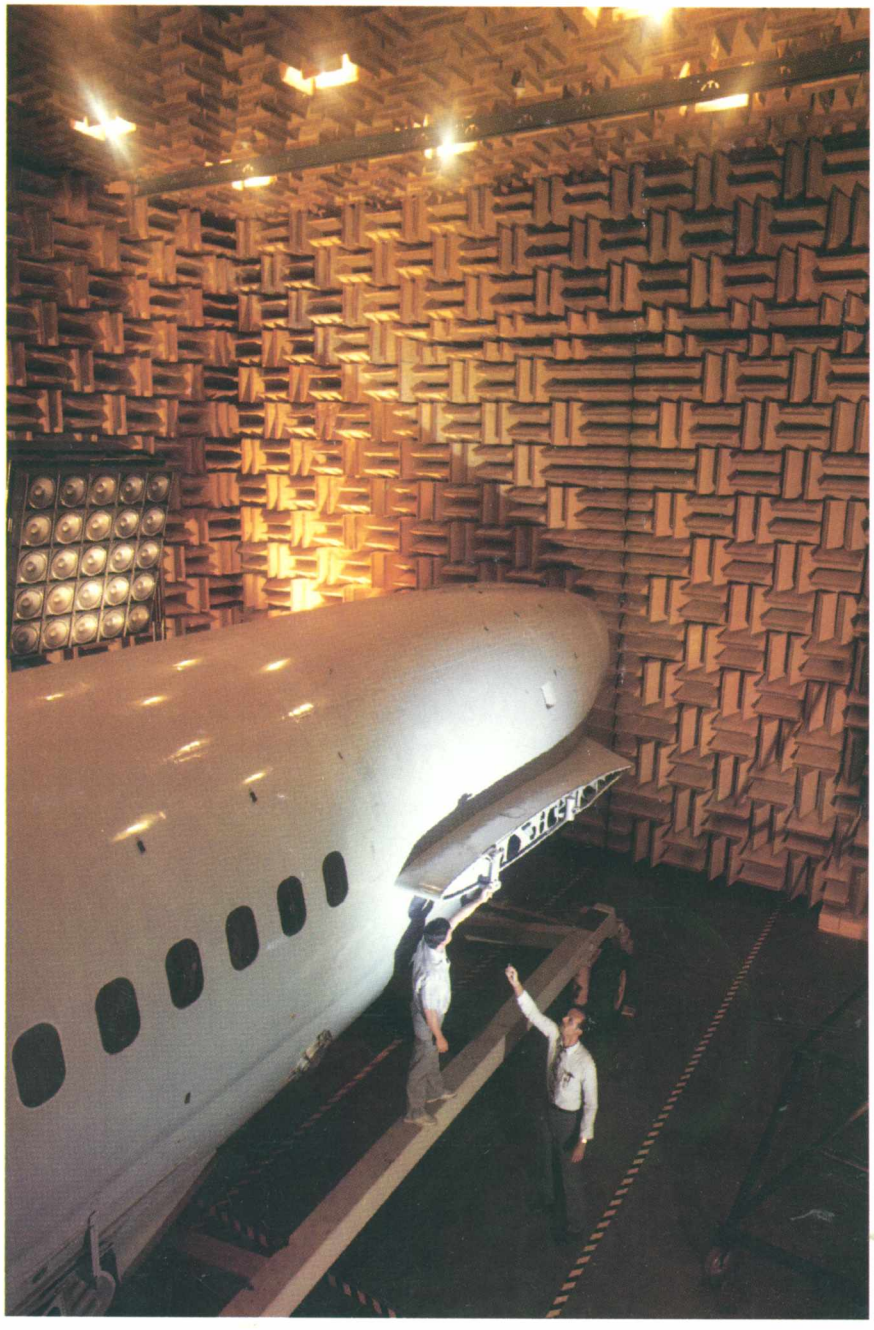

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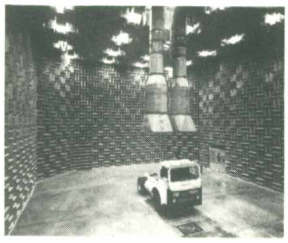

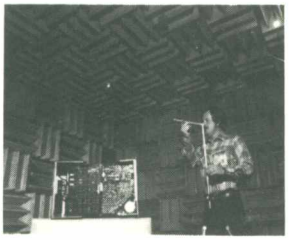

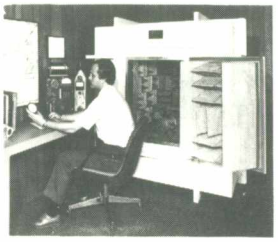

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