

# PROCEEDINGS

1980 International Conference on Noise Control  
Engineering

Noise Control for the 80's

inter-noise  
80

Edited by  
George C. Maling, Jr.

Volume I

# PROCEEDINGS

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Miami, Florida  
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Noise Control for the 80's

**Inter-noise  
80**

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The Institute of Noise Control Engineering of the United States of America, Inc. (INCE/USA) is a non-profit professional membership society founded in 1971. A primary goal of the Institute is to advance the technology of noise control with particular emphasis on engineering solutions to environmental noise problems. Membership in INCE/USA is open to qualified specialists in acoustical and noise control engineering. INCE/USA publishes two bimonthly periodicals. NOISE/NEWS contains news briefs, review articles and information on what is happening in the rapidly advancing field of noise control. The journal NOISE CONTROL ENGINEERING contains refereed technical articles and survey papers on applications of engineering principles to environmental noise problems. The INTER-NOISE conferences were initiated in 1972 when the first conference was held in Washington, D.C. In 1974, International INCE was founded as an international organization with national societies as its members. A major purpose of International INCE is to coordinate and sponsor the organization of international conferences in the field of noise control engineering. Since the inception of the INTER-NOISE series in 1972, INCE/USA has been given the responsibility for organizing the INTER-NOISE conferences in even-numbered years. The Board of Directors of INCE/USA was pleased to have been invited to make arrangements for INTER-NOISE 80 held in Miami, Florida during December 1980.

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  - 07. Definitions and descriptors
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  - 11. Noise-generating devices (including components & subassemblies)
  - 12. Stationary noise sources (noise generation and control)
  - 13. Moving noise sources (noise generation and control)
  - 14. Specialized industrial machinery and equipment
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  - 21. Physical mechanisms of noise generation
  - 22. Natural sources of noise
  - 23. Propagation, transmission and scattering
  - 24. Sound propagation in the atmosphere
- 30. **NOISE CONTROL ELEMENTS**
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  - 32. Enclosures for noise sources
  - 33. Seals for openings
  - 34. Filters, mufflers, silencers and resonators
  - 35. Absorptive materials
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## FOREWORD

"Noise Control for the 80's", the theme of the 9th International Conference on Noise Control Engineering is reflected in the papers that comprise this volume. INCE/USA, in its role as an organization devoted to the application of engineering principles to environmental noise problems, has organized INTER-NOISE 80 to make possible communication between engineers and others working in various aspects of noise control. The papers in this volume will be useful not only to those who attend the conference but also should serve as a valuable reference for other workers in the field.

In organizing a book such as this, one has to consider both the needs of the participants at the conference and the ease with which papers can be located in the volume subsequent to the meeting. In this volume, we have, for the first time, arranged the papers by the INCE Classification of Subjects which was developed during 1979 and early 1980. Although the first two sections of this Proceedings have been specially arranged, the vast majority of the papers follow the classification scheme which is outlined below.

In the first section, a draft of the INCE long range plan for noise control is presented. This working document, which is subject to future revision, lays out a plan for the identification and control of various sources of environmental noise. This material is in the first section of the Proceedings entitled **Long Range Plan**.

Following the theme of the meeting, three papers have been prepared on key problems for noise control in the 80's. The first, by Tony F.W. Embleton, deals with sound propagation outdoors; the second, by Harvey H. Hubbard and Homer G. Morgan, deals with the future in aircraft noise control. The third paper by Theodore J. Schultz deals with the future of building acoustics. These papers appear in the second section of this Proceedings under **Distinguished Lecture Series**.

The remaining nine major sections of the Proceedings are indexed according to the INCE Classification of Subjects mentioned above. The next section of the book contains a paper on the history of noise control, a series of papers on education in acoustics and noise control and several papers which deal with the noise programs of Federal, State and local governments. These subjects are found in the third section of the book, **General**.

The next group of papers covers noise generating devices of all kinds: stationary noise sources including large equipment and construction equipment, moving noise sources including aircraft, highway vehicles and trucks, and specialized industrial machinery and equipment such as that used in the fabricated metals industry and in mining. All of these papers appear in the fourth section of the Proceedings indexed under **Emission: Noise Sources**.

The next section is short but contains several papers of interest on sound propagation. These papers are indexed in the fifth section of the Proceedings under **Physical Phenomena**.

Elements such as barriers, silencers and acoustical materials form an important part of noise reduction. The sixth section of this Proceedings contains a large number of papers in this general area. A group of papers on noise barriers forms the first part of the section and papers on silencers and on materials follow. This section also covers ear protective devices and noise attenuation in ducts. One group of papers on active noise absorbers has also been included. These devices, which

cancel sound with sound, are being studied by groups of workers in the United States, England and France. All of the above subjects are indexed in this Proceedings under the heading **Noise Control Elements**.

The seventh section of this book covers the topics which deal with vibration. Only a few papers appear in this section and all are concerned with sound propagation in structures. The papers in this section of the Proceedings are indexed under **Vibration: Generation, Transmission, Isolation and Reduction**.

A number of papers in this Proceedings deal with the physical aspects of environmental noise. This section in the Proceedings is very broad in that it covers papers on building noise control, community noise control, including several papers on land use planning around airports, and noise in the community due to traffic noise and rail vehicle noise. Also included in the section is in-plant noise control. The papers in this section of the Proceedings are indexed under **Immission: Physical Aspects of Environmental Noise**.

The other side of the immission problem deals with the effects of noise. The papers in this section deal primarily with hearing loss and with the psychological effects of noise such as annoyance; these are indexed under **Immission: Effects of Noise**.

The ninth section of the Proceedings covers a wide variety of topics such as instrumentation systems, measurement techniques, test facilities, analytical methods and modeling. Several papers deal with sound level meters and dosimeters and a group of papers has been prepared which deals with instrument calibration and certification. All of these papers are indexed in this Proceedings under **Analysis**.

The final portion of the Proceedings deals with standards and with Federal, State and local legislation and regulations. Also included are papers dealing with auditing, enforcement and certification. These papers are indexed in the Proceedings under the heading **Requirements**.

The editor is very grateful to the authors of the more than 250 papers which appear in this Proceedings. The task of assembling these papers was facilitated by the careful attention to details by each of the authors. On behalf of INCE/USA, I would like to thank all of the authors for their contributions. I am also grateful to Beverly Bishop, Bertha Burns, Janet Moss and Joyce Raymond for their assistance with the editorial mechanics that made this volume possible.

GEORGE C. MALING, JR.,  
*Editor*

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