ANSI TECHNICAL REPORT

BUBBLE DETECTION AND CAVITATION MONITORING

ANSI S1.24 TR-2002

Accredited Standards Committee S1, Acoustics

Standards Secretariat
Acoustical Society of America
35 Pinelawn Road, Suite 114E
Melville, NY 11747-3177

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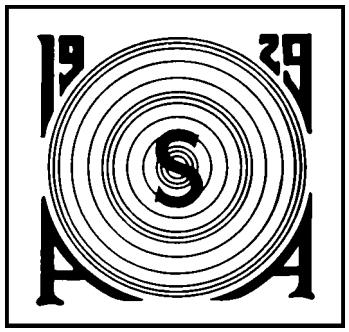

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Abstract

This Technical Report provides descriptions of 25 techniques that have been found useful for detecting and characterizing small gas-filled cavities or bubbles, and for monitoring cavitation activity. Acoustical, optical and electrical methods are among those employed for determining numbers, sizes and spatial distributions of bubbles. Physical, chemical and biological tests are used in monitoring cavitation activity. The procedures described have been applied to medicine, to oceanography and to materials processing. Guidance is offered on the techniques which have been found suitable for specific applications. Advantages and disadvantages are discussed. References are provided for further reading.

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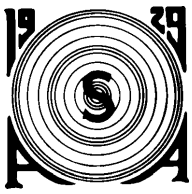

Standards Secretariat
Acoustical Society of America
35 Pinelawn Road, Suite 114 E
Melville, New York 11747-3177
Telephone: 1 (631) 390-0215
Telefax: 1 (631) 390-0217

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Foreword

[This foreword is for information only and is not an integral part of ANSI S1.24 TR-2002 *ANSI Technical Report Bubble Detection and Cavitation Monitoring*]

Few liquids or solids are homogeneous; most contain cavities filled with air or other gas. The cavities may be large enough to be obvious, or may be very small. They may be desirable, as in foods or lightweight construction materials, or harmful if they cause weakness in structures or if they cause decompression illness during underwater or space activities. In diagnostic medicine, small gas-containing particles are introduced into the circulation to improve ultrasound images. In lakes and oceans, bubbles produced at the surface provide needed oxygen for aquatic life, but they present difficulties for sonar or other operations dependent on sound propagation. In industries it is sometimes desired to introduce gas into manufactured products, but the appearance of unwanted gas bubbles can be a serious problem.

Gas-filled cavities respond to a sound field in a complex activity known as acoustic cavitation. This includes simple breathing oscillations, shape oscillations, high-speed travel, jet formation, dramatic implosions, fragmentation, and interactions between bubbles. The high temperature produced in the gas phase during implosions leads to production of sonochemicals and/or sonoluminescence. The mechanical stresses and chemicals produced by acoustic cavitation are capable of causing a host of physical, chemical and biological effects which can be desired, as in sonic cleaning or sterilization, or harmful if unwanted chemical action or solid erosion is produced.

Many methods have been devised for detecting and sizing gas-filled cavities, for determining their distributions in space and time, and for monitoring their activity. In this report, 25 techniques are described by authors with knowledge and experience. Principles of operation are explained and applications discussed for each of the varied techniques. It is expected that there will be increasing need for this kind of information in the future, and it is hoped that this report will be a useful resource.

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Standards Secretariat
Acoustical Society of America
35 Pinelawn Road, Suite 114E
Melville, New York 11747-3177
Tel: 631-390-0215
Fax: 631-390-0217
E-Mail: asastds@aip.org

This Technical Report was developed under the jurisdiction of Accredited Standards Committee S1, Acoustics, which has the following scope:

> *Standards, specifications, methods of measurement and test terminology in the fields of physical acoustics, including architectural acoustics, electroacoustics, sonics and ultrasonics, and underwater sound, but excluding those aspects which pertain to safety, human tolerance and comfort.*