# Acoustic Emission

## Standards and Technology Update

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editor

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# *Acoustic Emission: Standards and Technology Update*

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# Foreword

This publication, *Acoustic Emission: Standards and Technology Update,* contains papers presented at the symposium of the same name held in Plantation, Florida, on 22–23 January 1998. The symposium was sponsored by ASTM Committee E7 on Nondestructive Testing. The symposium chairman was Sotirios J. Vahaviolos, Physical Acoustics Corporation.

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# Overview

Acoustic Emission (AE) has been commercially available for more than thirty (30) years. Has any progress been made? The purpose of the Symposium held in January 1998 in Plantation, Florida was to discuss the evolution of the technology of AE over the years in instrumentation, applications, standards and codes and its overall worldwide acceptance. Authors have made comparisons between AE and other Nondestructive Testing (NDT) technologies as to their suitability in solving practical industrial problems worldwide.

As the newcomer in the Nondestructive Evaluation (NDE) industry, AE was first tried on applications where other NDT technologies had previously failed or was used where wild financial cost savings were promised. The issue of suitability of AE for an application was never considered until the very late 70's and early 80's, when a new breed of industrial and university researchers entered the field in USA, Europe and Japan. AE "noise counting" was replaced with basic work on source characterization, wave propagation, mode conversion, the study of the inverse problem using a number of Green's functions, pattern recognition and, most importantly, they considered AE as a science, using all available tools at their disposal. While the university academics worked hard to identify certain AE waveform features with source and failure mechanisms, a number of industrial researchers explored a myriad of "Pseudo-sources" of AE and their statistical nature. Instead of absolute one-on-one correlations and exact location of defects, practitioners developed zonal location and data bases based on case studies that enabled them to relate AE to fracture mechanics, corrosion phenomena, and overall part integrity assessment, especially in composite structures first and then in pressurized systems and individual components. The introduction of artificial intelligence, coupled with existent data bases, led to the development of ready-to-use knowledge-based systems based on very complex structures that are found in power utilities, refineries, chemical plants, complex pipelines, wind tunnels, aircraft structures, etc. The hard work of the late 70's and early 80's by CARP (Committee on AE for Reinforced Plastics) and the wide application of AE in testing of Fiberglass (FRP/GRP) vessels and pipes rejuvenated the technology! Eventually they became ASTM Standards now widely in use.

The well-publicized early failures of AE in several metal vessels tests, especially in Europe by **INEXPERIENCED** personnel, were now reconsidered. Unknown to most AE Researchers/ Practitioners a behind the scenes branch of CARP known as CAM (Committee for Acoustic Emission for Metal) start looking carefully utilizing vast experience in Fracture Mechanics, Civil Engineering, NDT and, most importantly, vessel construction maintenance and use, realized early on that the same inexperience that prevented the use of AE in FRP in the early 70's has prevented users to do Metal Vessel Testing by AE.

With the help of the "core members" of CARP, metal vessel testing was reconsidered, especially after the successes of MONPAC™ (a commercially available knowledge-based expert system that formed the basis of acceptance of AE by American Society of Mechanical Engineers (ASME) and Department of Transportation (DOT) and, thus, gave credence to the newcomer NDE technology). In addition, the more than ten AE ASTM Standards and AE's acceptance by American Society for Nondestructive Testing (ASNT) as another major NDT technique and the establishment of Level III in AE were major steps forward for the technology worldwide.

In this Symposium basic important work is being presented that constitutes the basis for Natural Gas Vehicle (NGV) Cylinder Testing with AE, no matter how controversially some people might view their work. When properly applied, AE can save NGV assets for customers as the ASTM FRP vessel has done for the past 10-plus years.

It is interesting to note that infrastructure and slope stability applications worldwide and especially in Japan are now to the point of standardization of existing working procedures. We were very much encouraged by the continuing success of the Reciprocity Method for Calibrating AE Sensors and hope that it eventually will become another ASTM Standard. As for the other applications, I can only comment on their existing uniqueness from micro damage in bones to burning of grinding tools in high speed manufacturing.

We hope this publication will prove interesting to a wide spectrum of readers, especailly those who look for new AE Standards and are interested to explore the future directions for the application of the Acoustic Emission Technology.

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