The Acoustic Emission Company

vallen systeme

# Acoustic Emission Testing Application Overview

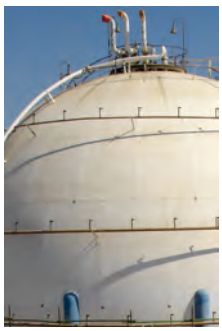
**Corrosion ▪ Integrity**
**Leakage ▪ Partial Discharge**
**Structural Health Monitoring**
**Research and Development**

## Integrity Testing

Industrial processes often involve storing and processing of hazardous materials. Failure of such storage or processing equipment may have catastrophic consequences on environment or people. Hence governments impose strict regulations on operators of industrial plants demanding inspection of equipment on a regular basis. In many countries, AE-testing is an accepted inspection method in combination with another volumetric NDT method such as ultrasonic testing (UT). The result of an AE-test reveals defects which can be followed up by e.g. UT to determine size of and map defects.

An AE-test can be done with the working or storage medium. A time consuming emptying of equipment with subsequent internal inspection and/or a hydro test is not necessary. An AE-inspection guarantees minimum downtime of equipment and a highly reliable inspection result.

An AE-test detects and locates active defects in the object under test. Analysis of data allows distinguishing severity of AE-sources. Classification of sources will decide what kind of further actions are required.



## Corrosion Testing

Corrosion is an imminent danger for containments in which a corrosive medium is stored. Advanced corrosion leads to leakage and in its worst case even loss of integrity. Any such failure implies loss of asset and the risk of additional damage compensation costs. A leaking medium may pollute environment and be hazardous for people. Hence it is vital for an operator to know the condition of storage containments in order to schedule maintenance.

AE-testing is a method for screening active corrosion and active leakage in storage containments. The test method exploits acoustic emissions of corrosion process or leaking medium. It is a non-intrusive method without the need of opening and cleaning the storage containment prior to inspection. The result of an AE-test poses a recommendation for a maximum operation period until a subsequent inspection is necessary.

Corrosion of the flat bottom of above ground storage tanks has been screened with AE for many years now. Corrosion sources can be located and classified into classes of different severity by analyzing AE-data. The operation period until next inspection is based on a corrosion source's severity.

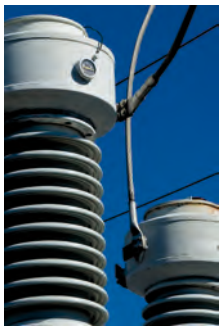
## Leakage Testing

Leakage in valves, pipelines or storage tanks causes loss of transported or stored medium, i.e. your asset, pollution and danger factors to environment as well as people. For safety reasons and asset protection leak testing is an important task for operators of plants and pipelines.

AE-leak-testing is a non-intrusive method of detecting, quantifying and locating leaks. Friction of leaking medium generates sound waves in the ultrasonic range which can be detected and analyzed by an AE-measurement system.

Pipelines of any diameter can be inspected without the necessity of complete access to the pipeline. AE sensors need to be mounted in certain distances which guarantee that the waves reach at least two sensors for linear location.

## Partial Discharge Testing



Partial discharge, an electrical phenomenon, is a localized dielectric breakdown. Partial discharges cause a progressive deterioration of insulating materials, which eventually leads to electrical breakdown. Such an electrical breakdown may ultimately lead to complete failure of equipment. Failure must be avoided especially for very expensive equipment such as transformers used in power generation or smart grids. Electrical power supply reliability for consumers and industry depends critically on sustained operation of these transformers.

Integrity of insulation has to be monitored and confirmed during manufacturing stage and during operation in regular intervals. Regular inspections can trigger early warning signals for maintenance.

AE-measurement is a suitable method to detect and locate partial discharge in transformers. It is a non-intrusive method and capable of monitoring the whole volume of a transformer. An AE test can be conducted while the transformer is in service.

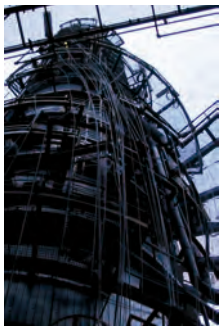
## Structural Health Monitoring

Structural Health Monitoring (SHM) is able to detect damage of an engineering structure and provides means of analyzing acquired data. SHM is characterized by monitoring an engineering structure such as bridges, dams, buildings, etc. over long periods of time by the use of a number of sensors. Because of the large amount of acquired data a statistical approach to data analysis is necessary.

The result of SHM shall provide an operator or owner of engineering structure reliable information regarding the integrity of a structure. SHM is based on the assumption that assessment of damage requires a comparison between two (time separated) system states.

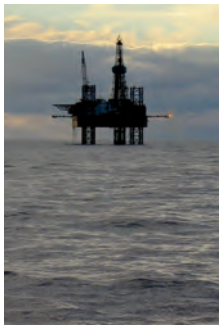
SHM by the use of Acoustic Emission has the advantages that the AE method can detect actively growing flaws while other methods require periodic inspection to make sure whether a crack is active or not. Since repair of existing cracks can sometimes do more harm than good to a structure, it is necessary to determine whether a defect is benign or active before repairs are made.

The AE method can locate remote or hidden flaws. This excludes the need for direct and close access to the locations of defects.



The AE method is one of the few NDE (nondestructive examination) methods which are appropriate for long-term continuous monitoring of flaws. The AE method is more sensitive than other NDE and can detect even incipient flaws. Other methods, which are highly dependent on defect size or surface opening, are only able to detect defects reliably after they have progressed beyond a certain size.

For SHM purposes reliably working equipment is needed which can acquire, analyze and issue warning or alarms in real time and autonomously for 24 hours a day, 7 days a week. Vallen Systeme delivers measurement equipment which fulfills the requirements of SHM.



## Research and Development

AE provides a very sensitive, volumetric and real time measurement technique which interferes only marginally with the specimen and is able to detect damage processes at the very onset. In most cases AE-measurement results are used to improve design of materials. i.e. increase their strength. Application of AE is not limited to improve engineering materials. AE is also used to investigate drying process of wood, water transport in trees, fatigue fracture of bones, degradation of implant-bone tissue interface, etc.

AE-measurements can be used in a wide range of applications to gain knowledge and deeper understanding of a material's behavior under load.

## About Acoustic Emission

Acoustic Emission (AE) is a phenomenon whereby transient elastic waves are generated by e.g. plastic deformation, crack propagation, erosion, corrosion, impact or leakage [EN 1330-9].

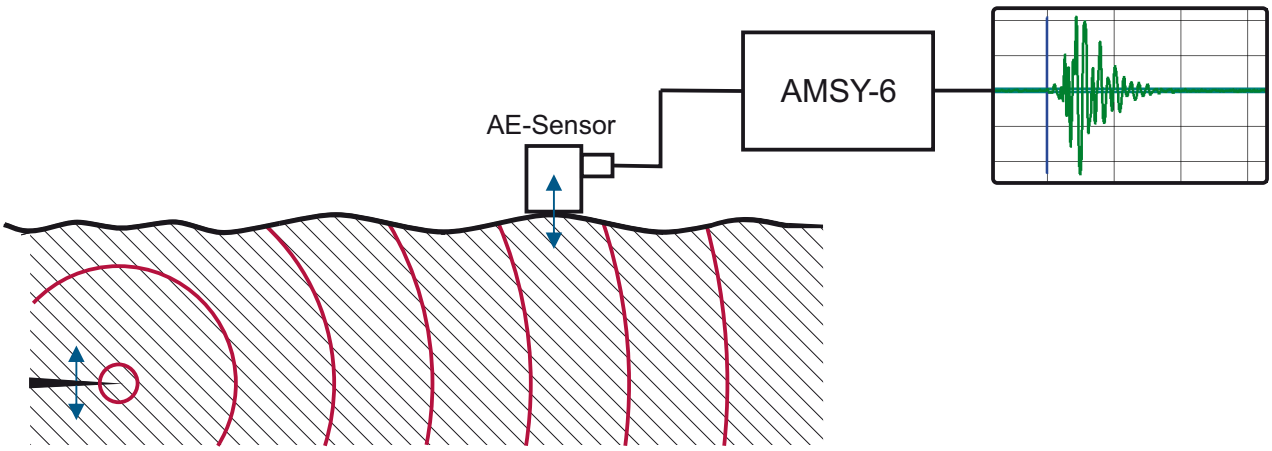
A sudden release of elastic energy is the mechanism giving rise to emission of transient elastic waves. This is the case for plastic deformation, crack propagation, erosion, corrosion and impact. An exception poses leakage, where the mechanism for emitting transient elastic waves is friction of flowing medium.

Once a transient elastic wave is generated it will propagate in its medium and eventually reach a surface. The interaction of the transient elastic wave with a surface causes surface motion. Acoustic emission sensors mounted on a surface are able to pick up its faintest motion and convert it into an electrical signal. The electrical signal of an acoustic emission sensor can be processed and features of it extracted. Extracted feature data and transient signal data (waveforms) are analyzed online in order to locate and infer about its source mechanism.

Acoustic Emission is usually monitored above the audible frequency range in a band from 20kHz to 5MHz. It has proven favorable recording transient elastic waves of crack processes in the frequency range of 100kHz-300kHz. A frequency range between 20kHz to 100kHz is more suitable in case of very large objects. Only in very noisy environments AE is measured in high frequency domain ($f$>300kHz).

Acoustic Emission is attractive because it is an integral, dynamic and passive, real-time measurement method. AE is integral because large objects can be monitored by use of only a few stationary AE-sensors. Even defects from inaccessible locations can be detected. AE is dynamic because it detects and is able to analyze a defect at the time of its occurence. Hence AE can be used as real-time measurement method. AE is passive since stimulating AE-sources requires loading the test object.

Because the physical process of acoustic emission occurs in a wide variety of materials and under a large range of loading conditions, the method offers great potential for use as an on-line monitoring tool. Due to its inherent advantages as compared to other techniques, it should always be considered when real-time detection and location of defects is required.




**Vallen Systeme GmbH**
Buergermeister-Seidl-Str. 8
82515 Wolfratshausen, Germany

Tel: +49 8171 38391-0

e-mail: sales@vallen.de
internet: www.vallen.de

Represented by: