Acoustic Monitoring International, Inc.

The story of *Acoustic Monitoring International* began in 1982, when *Babcock and Wilcox* developed sensors for leak detection for high-pressure boilers. After unsatisfactory results in trying to re-apply existing technologies to steam boilers, B&W contracted with *Hartford Steam Boiler Inspection Technologies* to design a special system to their particular specifications. *HSBIT's* Micheal R. Shaw was given the task of designing the system—the ALL™ Acoustic Leak Locator.

After the initial installation of the ALL™ system at Alabama Power's Gaston Station in 1991, B&W purchased *HSBIT*, and created *TotalSCOPE Products and Services* for boiler operating efficiency. Mike Shaw moved to Babcock & Wilcox at this time to continue his work with the ALL™ system.

In 1997, *B&W* sold the assets of the ALL™ System to Micheal R. Shaw, and *Acoustic Monitoring International, Inc.* was born.

AMI immediately began servicing units all over the world that were under *B&W's* warranty, and continues to provide parts for all existing systems.

Since its inception, *Acoustic Monitoring International* has established over 35 new installations of the ALL™ system.

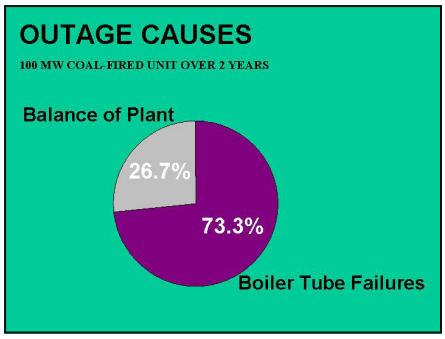
With over 2,000 sensors in service in over 10 different countries, *AMI's* ALL™ system has been thoroughly field-tested and is extremely reliable. *AMI* is constantly improving the system; the Acoustic Leak Locator is in its fourth generation.

Listening is our business.

Acoustic Monitoring International, Inc. (330) 305-1422 www.acousticmonitoring.com

The Problem:

- High pressure leaks cause extensive damage to adjacent components
- Normal detection methods (manual inspection, makeup water use, temperature monitoring) can only find leaks of significant size that are already causing major damage
- Undetected leaks can cause unexpected downtimes
- Downtime cost can be significant, based on:
  - -the number of tubes needing repaired
  - -the types of repairs needed
  - -the amount of outage hours the unit is off-line and unavailable
- Downtime at peak hours incurs high replacement power costs (sometimes exceeding $100,000 per day)



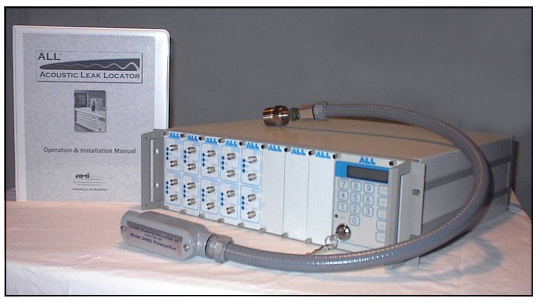

Undetected leaks cause extensive damage

The Need:

- Early detection of high pressure leaks so that damage is controlled
- Advanced notice of leak problems to minimize costs due to damage
- Controllable downtimes for repairs to lower power replacement costs

The Solution:

- ALL™ is a leak detection and warning system designed for on-line monitoring of pressurized systems and valves
- ALL™ can detect leaks as small as 5 mils--long before make-up water alarms
- ALL™ tells you that problems are developing before the situation becomes serious
- ALL™ provides the detailed data needed to know whether to make immediate repairs or simply schedule future maintenance at an opportune time



The Benefits of ALL™

⇒ **Vital Early Warnings**

⇒ **Significant Cost Savings--usually pays for itself after just one leak**

⇒ **Accurate Leak Location**

⇒ **Modular in Design**

-Can be installed in different configurations—from 2 channels up to 16 channels per unit. Only the number of channels needed for any given application can be purchased, with the capability to expand the system at a later date.

⇒ **Multiple Leak Detection Capability**

⇒ **Monitor Leaks Throughout:**

Boiler

Steam Piping

Feedwater Heaters

Headers

Valves

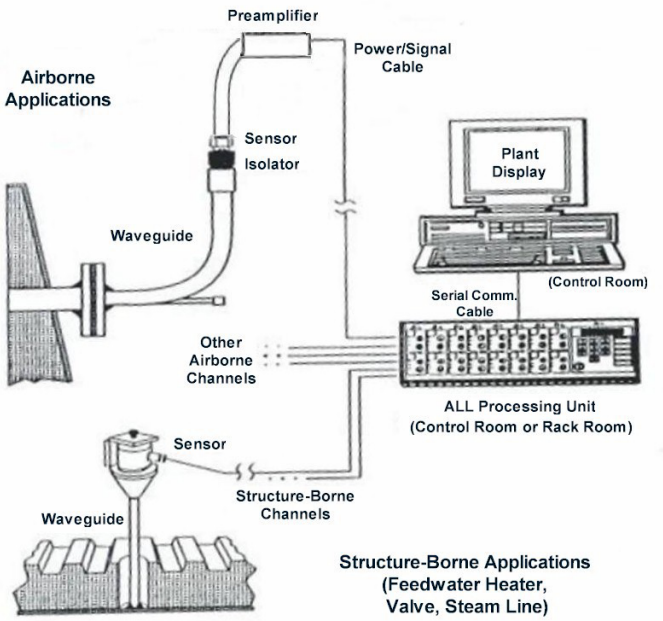
Other Pressure Vessels

⇒ **Flexible Output Options**

⇒ **Sophisticated and Accurate**

⇒ **Easy to Use**

How ALL works



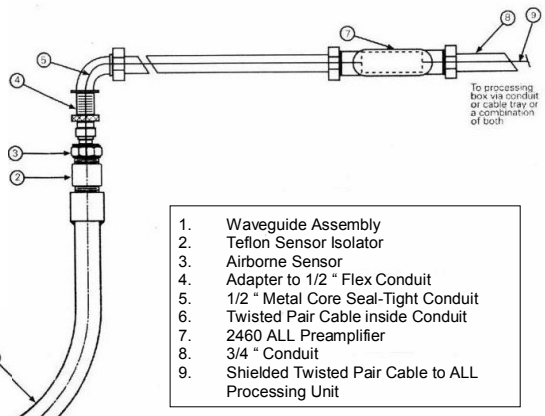
ALL™ detection technology is based on **high-frequency acoustic emissions** emanating from sites of gas or fluid leakage through orifices, cracks, and corrosion in pressurized systems.

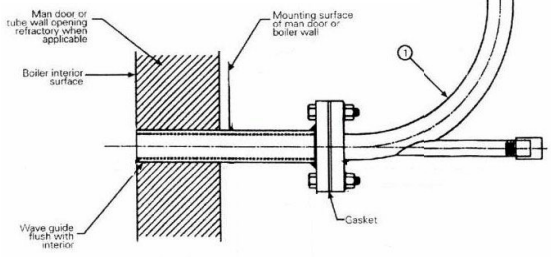
Sensitive piezoelectric **sensors** mounted to the structure on waveguides transform these acoustic waves to electronic voltage signals, which are amplified, filtered, and processed to determine energy content.

The signal output is **monitored continuously** on each channel, and **alarm levels** can be defined independently by channel so that **you will know exactly when and where a leak has occurred.**

Airborne Acoustic Activity Monitoring

To sense the sound in a boiler, AMI has designed **acoustic sensors mounted on the ends of waveguides**. The waveguides are mounted on boiler access doors, observation doors, or unused sootblowers ports. The waveguide provides a smooth continuous acoustic path (much like an ear canal) to the sensor and provides thermal protection by eliminating the direct radiant heat of combustion that could overheat the sensor. A secondary purpose of the waveguide is to prevent flyash or wash water from directly contacting the sensor diaphragm. The waveguides are either welded directly to a door or attached with a special fixture and oriented to place the acoustic sensors in as nearly a vertical position as possible.



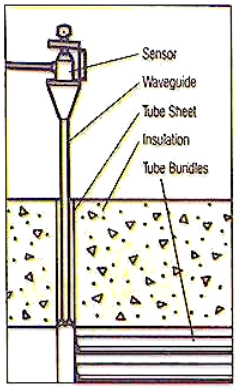


The **sensor** is a specially designed pressure transducer for detection of leaks in high pressure and/or high temperature environments on the gas side of furnaces and convection passes of boilers. It is a **highly sensitive pressure transducer** utilizing piezoelectric crystals with acceleration compensation circuitry to minimize extraneous signals due to mechanical vibrations. Due to the sensor's operating environment, its mechanical and electrical design was carefully designed to meet the following requirements:

- A rigid mechanical construction to avoid mechanical strains on the piezoelectric crystal that could induce unknown changes in sensitivity.
- Capability of absorbing very severe thermal shocks (550°F/sec.) without any sensor damage. High sensitivity coupled with extremely high resolution for detection of high frequency noise (leaks).
- High degree of reliability in presence of corrosive gas in the boiler environment.

Structure-borne Acoustic Activity Monitoring

When a pressurized fluid such as steam or water escapes through a **leak in piping, valves, or feedwater tubes,** it generates acoustic emissions which travel **through the component's structure**. Small holes generate high frequency acoustic emissions (above the audio frequency range) as the hole increases in size the low frequency complement of the acoustic emission increase and the airborne noise can be heard.



To detect these acoustic emissions early, **the structure-borne waveguide is connected to the component to be monitored.** The waveguide serves two functions: (1) it couples the acoustic emissions from the component to the sensing device and (2) it protects the electronic sensing device from the high temperature of the component being monitored.

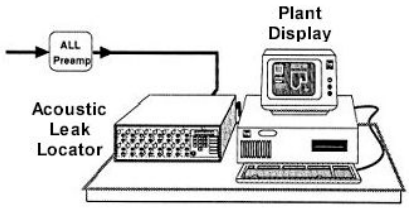
The sensing device is a piezoelectric crystal which converts the acoustic emission signals to low energy electrical signals.

Preamplifier

Housed in a conduit box between the sensor/waveguide and the Acoustic Leak Locator system, **the ALL™ Preamplifier provides the first stage of signal conditioning.** An operating boiler with no leaks has a characteristic low frequency (1 kHz) rumbling sound due to combustion noise. The sound level is typically quite high.

To improve the signal to noise ratio of the system, the ALL™ preamplifier is designed to filter acoustic frequencies below 1 kHz and amplify acoustic frequencies above 1 kHz. Up to 90% of the acoustic signal present is eliminated.

This allows the Acoustic Leak Locator system to be set to higher sensitivities for leak detection.



ALL™ Processing Unit

The signal is sent into the **self-contained Acoustic Leak Locator (ALL™) Processing Unit** where acoustic signal amplification and signal conditioning is completed for suitable processing. The ALL™ system's **Dual Signal Processing Unit** receives the analog acoustic activity signal, processes it and compares it to preset levels and timing parameters.

The results are available to the plant's existing computer system in your required format (as 4-20 mA signal level, alarm relays, and RS232 serial i/o) **for graphic display and alarms.**

ALL™ provides all the data needed for a **clear and accessible visual display of acoustic activity.** Levels of alert are predetermined, so that **when there is a significant change in activity on any channel you can know a leak has occurred.**

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Documented Cases

The Acoustic Leak Locator (ALL™) has been in service since 1991, with the original installation at Alabama Power Company's Gaston Station. Since then, over **90 different locations** in **10 countries** have installed the ALL™ system, with **over 2,000 sensors in service**.

Baltimore Gas & Electric and **Dayton Power & Light**

- Average 12 hours of downtime saved for each leak
- Stuck soot blower discovered prior to major damage
- Repair crews in and out in 8 hours

Cinergy and **American Electric Power**

Complete outage avoided because ALL™ determined that there were no leaks while malfunctioning makeup water sensors indicated leaks

Mississippi Power

Faulty soot blower shutoff valve detected during initial system setup

Alabama Power

Main steam line leak detected before penthouse was damaged

Cleveland Electric

- Internal valve leak discovered 3 months prior to any audible/visible warning
- Valve repaired during scheduled outage – saved on replacement power
- Only seals damaged

CISE (Italy)

- Experience has shown that monitored FW heaters have only 1 or 2 leaking tubes
- Better heat rate when returned to service
- Limits eventual retubing

Acoustic Monitoring International, Inc.

Key Features

ALL™ sensors are rugged, reliable, and proven. In more than 2,000 installations, 95.5% of our sensors have never failed in normal operation.

- Airborne, structure-borne, and combined applications are possible
- Modular design - 2 to 16 channels per enclosure
- Dual Signal Processing Modules
- Microprocessor Control in each module
- Programmable gain of 60dB in 2dB steps
- Bandwidth from 1KHz to 500KHz, unfiltered
- Jumper-selectable airborne/structure-borne filter range
- Continuous root-mean-square (RMS) signal processing on each channel
- Programmable HI and LO alarm thresholds and delays for each channel
- Solid-state alarm output relays (optional)
- 4-20 mA or 0-5 VDC analog outputs for each channel. For use on plant DCS
- All microprocessor boards are durable yet designed for easy replacement in minutes
- Local keypad or remote Personal Computer (PC) control of parameter settings
- Key-lock protection of parameter settings
- Parameter settings are retained after power loss
- RS-232 or RS-422 serial I/O communication option
- TCP/IP converter optional
- All modules are bus-connected for ease of troubleshooting

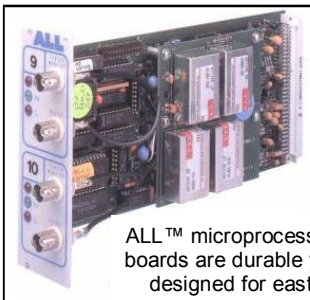
ALL™ with 10 Channels

AMI's Acoustic Leak Locator is modular in design.

- Can be originally configured from 2 to 16 channels
- Saves cost—purchase only the number of channels needed
- System can be expanded at a later date

AMI Technical Services

- One-day installation training
- Unlimited telephone technical assistance
- Available setup / maintenance / operation training, and installation inspection
- Warrantied for 18 months from date of shipment or 13 months from date of installation
- Exchange Repair Service--we troubleshoot down to what component needs repaired, and ship an exchange component overnight to you.



ALL™ microprocessor boards are durable yet designed for east replacement in minutes