

3/11/2011

doc.: IEEE 802.15- 15-11-0168-00-004k

Project: IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs)

Submission Title: Acoustic Leak Detection

Date Submitted: 5 March 2011

Source: Mark Wilbur **Company:** Collaborative Wireless Strategies

Address: Concord, Ohio USA

Voice: 01 (440) 221-2101 **E-Mail:** cws@ieee.org

Re:

Abstract: Acoustic Leak Detection

Purpose: Response to Call for Applications

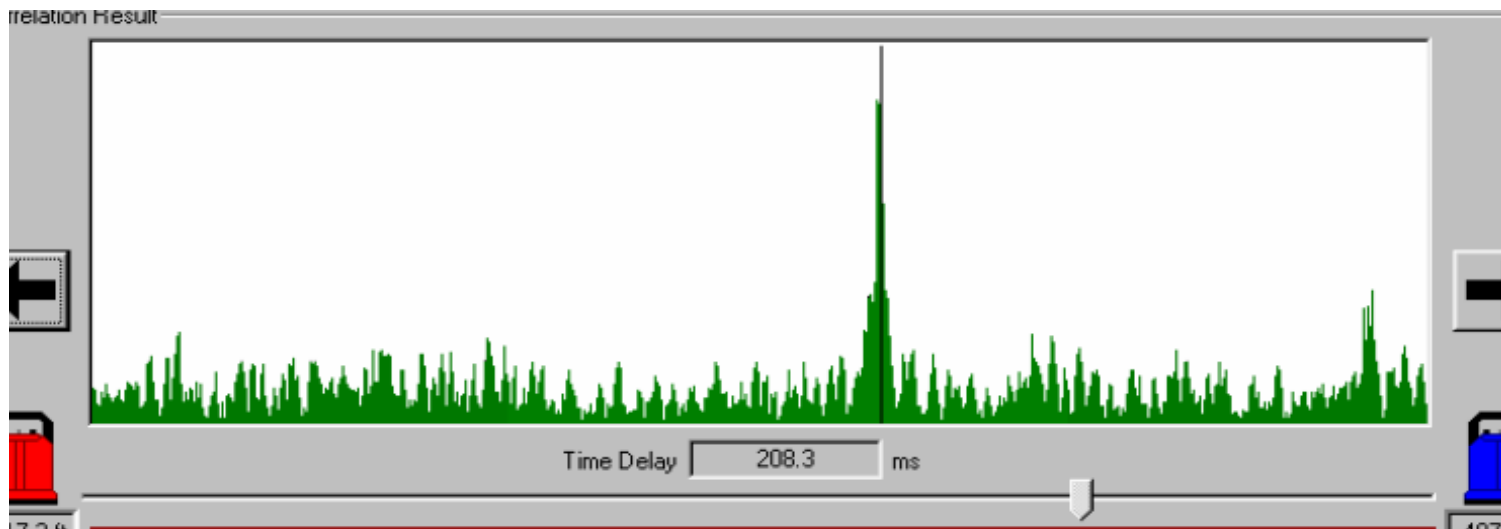
Notice: This document has been prepared to assist the IEEE P802.15. It is offered as a basis for discussion and is not binding on the contributing individual(s) or organization(s). The material in this document is subject to change in form and content after further study. The contributor(s) reserve(s) the right to add, amend or withdraw material contained herein.

Release: The contributor acknowledges and accepts that this contribution becomes the property of IEEE and may be made publicly available by P802.15.

In most water-distribution systems, a large percentage of the water is lost in transit from treatment plants to consumers. The amount of water that is lost or unaccounted for is **typically 20-30 percent of production.** Some systems, especially older ones, may **lose as much as 50 percent.**



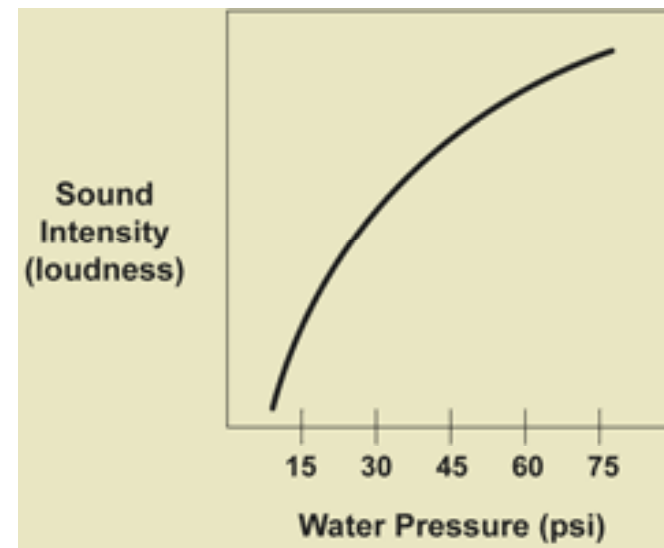
A correlator works by detecting the sound from the leak when it arrives at two sensor points on the pipe, either side of the suspected leak position. The sound arrives at the closer of the two sensors first; then there is a "time delay" (T_d) before the sound arrives at the farther sensor. This time delay, combined with knowledge of the distance (D) between the sensors and the velocity (V) of the sound in the pipe, enables the correlator to calculate the leak position (L)



Acoustic Signatures

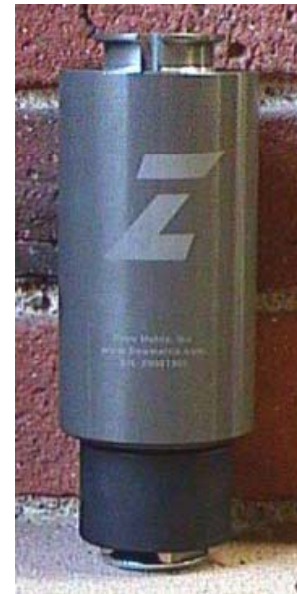
Pipe Material and Diameter Distance Sounds Travel for 2 GPM Leak at 60 PSI

- 6 inch Cast Iron Pipe 600 to 1000 feet
- 12 inch Cast Iron Pipe 400 to 800 feet
- 24 inch Cast Iron Pipe 200 to 400 feet
- 6 inch AC Pipe 400 to 800 feet
- 12 inch AC Pipe 300 to 500 feet
- 24 inch AC Pipe 100 to 300 feet
- 6 inch PVC Pipe 200 to 300 feet
- 12 inch PVC Pipe 100 to 200 feet
- 24 inch PVC Pipe 50 to 100 feet



Conventional Data Logger Limitations

Loggers must be installed and retrieved following each recording to sync recording time and extract data
Recording time must be selected prior to installation



Advantages of Wireless Data Loggers



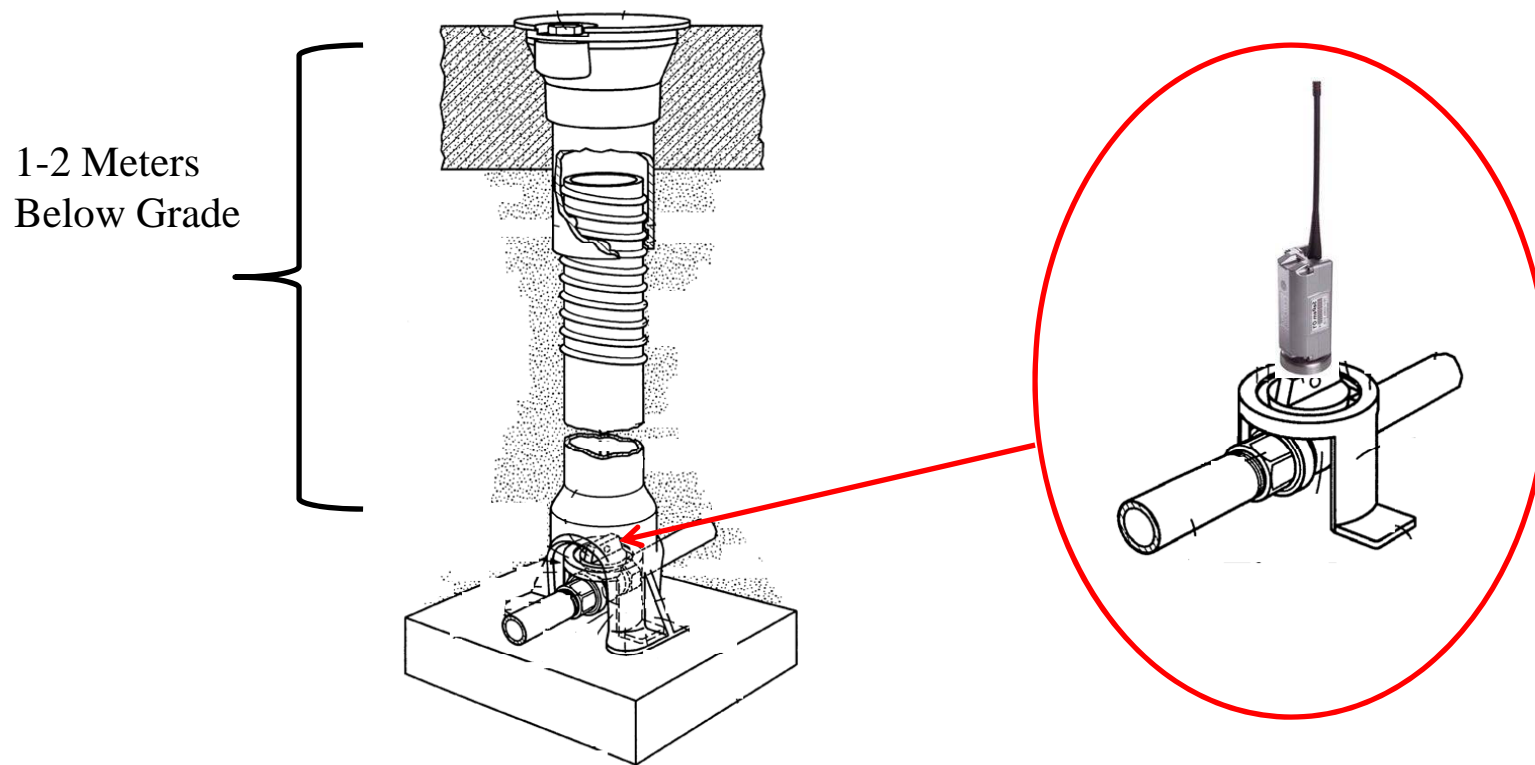
No truck rolls needed to retrieve units to extract recording data

Complete freedom to set and change recording times and durations

Completely automated leak detection with remotely configurable alarm threshold capability

Curb Valves

the utilities location of choice for recording devices
offer extremely challenging RF environments



RF Path Model



Data Collectors
20-30 ft above grade
Placed 1-2 miles apart



Typical Curb Valve Cover

Cast iron covers commonly exchanged for plasticized concrete to minimize path loss

~ 120 db path loss

Asphalt and Concrete Roads and Sidewalks



Data Model

The loggers continuously record the vibrations of the valve they have been mechanically coupled to using internally mounted accelerometer

Each logger establishes a typical baseline noise level during periods of relatively light utilization normally 2AM local time .

A beacon is transmitted from the system to start all recordings simultaneously providing greatly enhanced leak location accuracy over traditional data loggers

Each logger transmits a daily all clear that includes the baseline noise levels and battery voltage. This payload is typically <1 Kbit in size

When the recorded minimum noise level exceeds the preset threshold the loggers initiates a detailed vibration data collection process.

These larger recordings are typically 10-50 Kbit in size and are typically segmented into 256-512 byte payloads prior to being transmitted .

Key Performance Requirements

- Loggers independently establish baseline noise levels at current location
- Loggers transmit alarms independently if noise threshold exceeded
- *Loggers* transmit pre-programmed location data including GPS location data
- Long-lasting performance at least 5-years on factory replaceable batteries
- Secure and reliable RF path capabilities to ensure all data is received
- Long-range TX power to transmit data over a range of at least one mile
- Corrosion proof sealed design for submersion in harsh pit environments
- Two-way operation provides accurate time-synchronization and allows the user to remotely change the loggers settings
- Reports data such as battery condition, tamper and error status.
- Self contained timing accurate to 1 second in 24 hours
- 512 kbs available memory to store recordings

?Questions ?

