

Acoustic Leak Locator: SWANS II

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1. Introduction

Conventionally, the position along a buried pipe where the gas is leaking out or water is coming in (due to sand blasting, for example) is determined using a gas detector before the overlying earth is removed and the pipe is repaired. However, the detection and excavation take time, and restoration of the road section that was excavated in order to locate the leak is becoming more expensive.

This paper describes the acoustic leakage locator SWANS II (hereinafter referred to as SWANS II), which is capable of locating gas leakage or water penetration by analyzing the sound of gas leaking out or water coming in, using microphones attached to vertical pipes for metering.

2. Outline of the Unit

Photo 1 shows the appearance of the unit, and Table 1 lists its specifications.

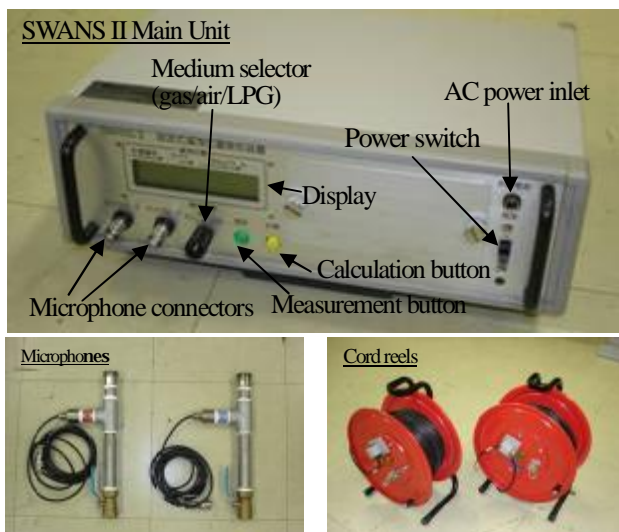


Photo 1 Appearance of SWANS II

Table 1 Specifications of SWANS II

Dimensions	315 mm × 230 mm × 100 mm (main unit)
Target piping	Any piping (no restriction on the diameter, material or buried depth)
Maximum distance to target	Approx. 50 m
Minimum detectable leakage	30 L/h (2.3 kPa)
Locating accuracy	±0.3 m
Analysis time	Approx. 30 seconds (from the collection of leak noise to the display of location)

3. Locating Principle and Location Display

As shown in Figure 1, Microphones 1 and 2 are attached to the vertical pipes for metering at two different customers that receive gas from the pipe section in question. The microphones collect the sound of gas leaking out or water coming in, which is propagated along the pipe. This sound arises from the position of the leak and reaches Microphones 1 and 2 at different timings. The unit converts this time difference into a distance from the mid point of the given pipe section and displays it as shown in Figure 2. A negative distance shows the distance from the mid point to the position of the leak that is closer to Microphone 1; a positive distance shows the distance from the mid point to the position of the leak that is closer to Microphone 2.

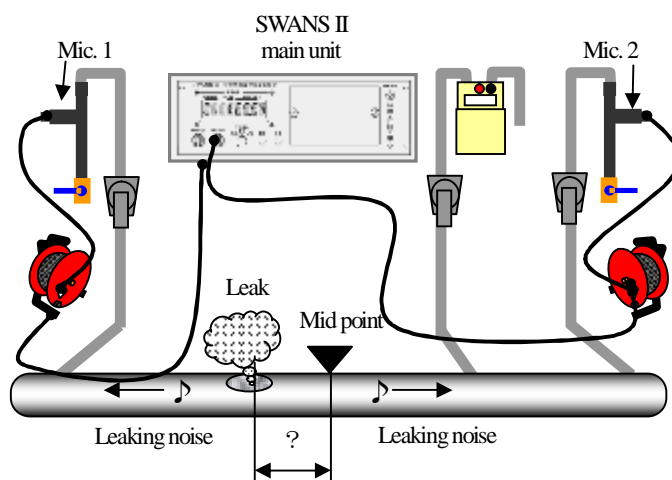


Figure 1 SWANS II Installation Method

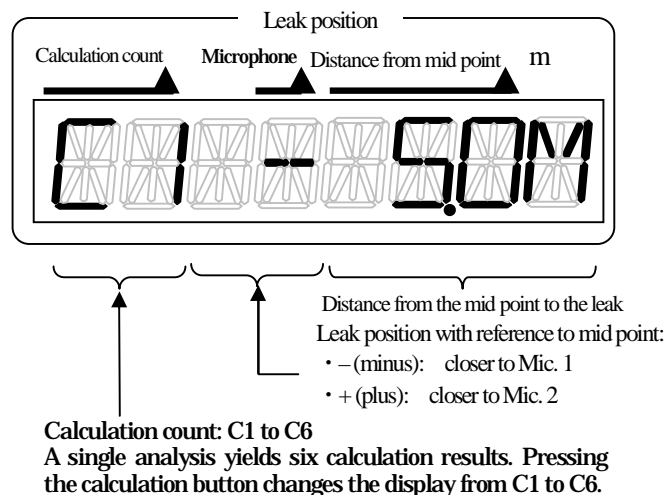


Figure 2 Location Display

4. Leak Locating Method

Figure 3 outlines the leak locating method. The locating procedure involves three steps in the order from (1) to (3) as explained below.

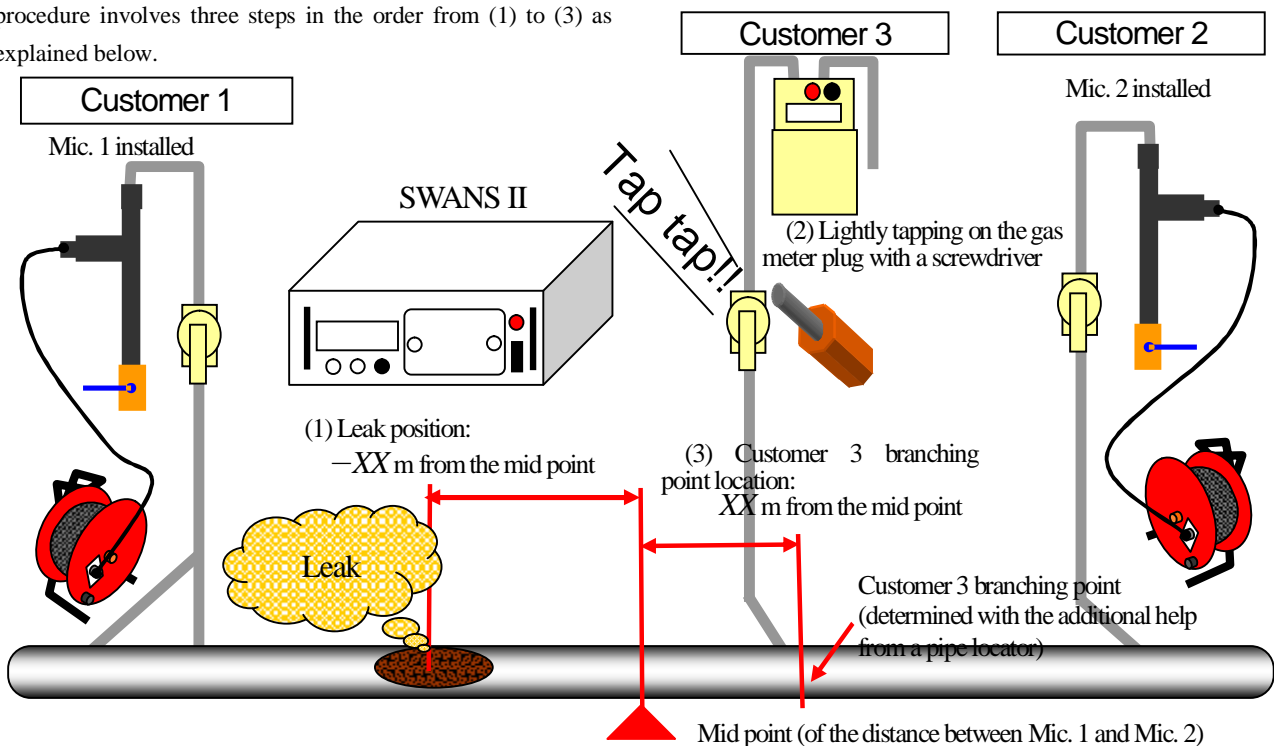


Figure 3 Outline of the Leak Locating Method

Locating procedure:

(1) Locating the leak point

Locating the leak point that is displayed “-XXm” from the ※mid point. ※How to find the mid point shows(2)

A negative distance shows the distance from the mid point to the position of the leak that is closer to Microphone 1; a positive distance shows the distance from the mid point to the position of the leak that is closer to Microphone 2.

(2) Determining the distance from the mid point to the Customer 3 branching point

Lightly tapping on the plug of the gas meter vertical pipe for Customer 3 with a screwdriver to produce a dummy leaking noise, use SWANS II to determine the position of the Customer 3 branching point in terms of its distance from the mid point. The branching point of the Customer3 has been found by using both SWANS II and pipelocator in advance.

(3) Locating the leak in terms of the distance from the Customer 3 branching point

This distance is given by subtracting distance (2) from distance (1).

Example: If distance (1) is -6 m and distance (2) is +2 m, then $(-6\text{ m}) - (+2\text{ m})$ yields -8 m.

5. Advantages

- There is no need for excavation.
- Locates the leak from a distance.
- The locating process takes only about 30 seconds, from the initiation of monitoring to the display of result.
 - There is no restriction on gas pipe type, diameter or underground.
 - The method can also be used to locate sand blasting or water penetration by sand blasting or minor water penetration into a PE tube (temperature rise during inspection).

6. Conclusion

SWANS II eliminates the need for excavation, locates the leak quickly, and is easy to handle. These advantages enable the method to speed up the repair of leaks, prevent secondary accidents, minimize the need for excavation and thereby reduce the cost for restoring the road after excavation.