BONDI-12

Water leakage detector

user manual

Shi jiazhuangBondi Technology Co., Ltd.

Preface

Dear valued customer!

Thank you for choosing to use the Bondi-12 Pipeline Leak Detector. If this is your first time using this product, please carefully read the following product description and usage instructions.

The Bondi-12 User Manual provides a detailed explanation of the components, functions, operational procedures, precautions, and methods for pipeline inspection and leak localization using the Bondi-12 Pipeline Leak Detector. Please ensure you thoroughly read and fully understand the contents of the user manual before operating or using the Bondi-12 Pipeline Leak Detector. If you have any questions regarding the operation or use of the Bondi-12, you may contact our company at any time by phone. We will provide you with prompt and dedicated technical support and service. Thank you for your cooperation!

Please keep the user manual properly for future reference. In case of loss or damage to the instruction manual, please contact our company immediately.

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1 Technical Specifications

Magnification	120db
Frequency range	200-4000Hz
Power supply	Lithium battery 8.4V 2000mAh, with matching charger
Operating temperature range	-20℃~+55℃
Continuous working hours	≥12 hours
Display screen	Liquid Crystal Display (LCD)
Filter	2 switchable channels
Detection depth	1.5m
Size	178mm×99mm×60mm

Table 1.2 Technical parameters of earphones

Playback method	Surround sound
Working principle	Fully enclosed monitoring headphones
Horn diameter	40mm
Response frequency	20Hz-22KHz
Impedance	32Ω

2 Instrument Composition

The Bondi-12 pipeline leak detector consists of a main unit and an accessory system.

The main unit of the Bondi-12 pipeline leak detector includes sensors and a control handle for acquiring leak signals, a main unit for leak signal processing and information display, as well as high-fidelity headphones for auditory identification of leak status. During leak inspection or localization, the host system displays the control status information of leak detection in both auditory and digital forms through the LCD screen on the main unit and the headphones.

2.1 Product Composition

The product composition of the Bondi-12 pipeline leak detector is shown in Table 2.1.

Table 2.1 Component composition of the detector

Host unit 1 piece	Multi-functional sensor, 1 piece	Indoor sensor 1 piece
		
Handle 1 piece	Earphones 1 piece	Charger 1 piece
		
A strap	Instrument case, 1 piece	
		

2.2 Host unit composition

The main unit is the principal component of the detector, comprising the host (including power supply, main interfaces, LCD display, etc.), control handle and sensor, earphones, battery pack, and charger. This section will elaborate in detail on the functional distribution, specifications, performance, and connection methods of the main unit's components.。

2.2.1 Host

Figure2.1Host

2.2 LCD screen display area

The working interface of the liquid crystal display is shown in Figure 2.2.

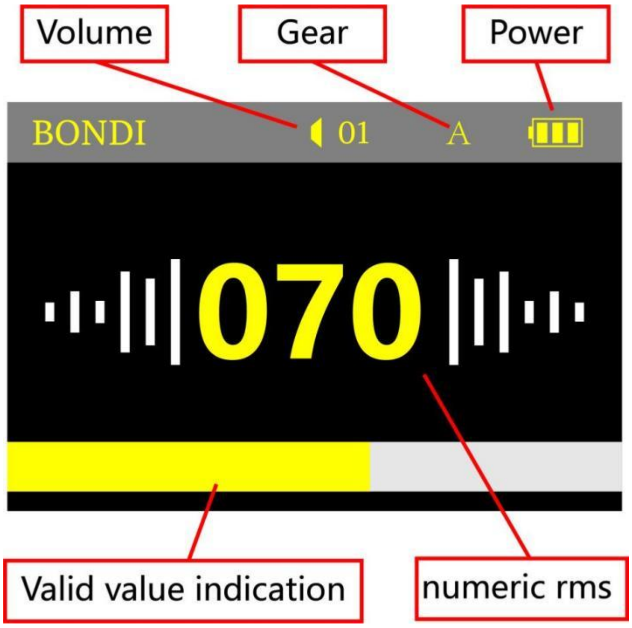

Figure 2.2 Operation Interface

The liquid crystal display is used to show the sound level bars of leakage, filter control information, and host status information.

The leakage sound intensity is displayed in real-time as proportional horizontal bar graphs within the area below the screen.

The digital value at the center of the LCD screen represents the effective RMS value of the leakage sound intensity within the most recent continuous detection time window (the time interval from when the handle button is pressed to when it is released).

2.2.3 Operation panel and main interfaces

The operation panel is distributed on the right side of the LCD screen, as shown in Figure 2.3

Figure 2.3 Operation Interface

Power switch(POWER)

After powering on, the main unit begins operation. Following initialization of the instrument's main unit, the screen remains in horizontal bar display mode. Upon shutdown, the power is cut off and the screen shows no display.

	After powering on/off, pay attention to checking the power status to prevent abnormalities.

Filter selection button (FILTER)

Users can select either filter channel A or B based on actual requirements to detect leakage signals, meeting the needs of leakage detection under different working conditions such as varying pipe materials/diameters and different work sections (buried layer media).

Volume regulation (VOLUME)

Users adjust the headphone volume according to actual needs and regulations.。

	Do not adjust the volume too high to prevent excessive sound intensity from impacting the auditory perception of the operator homo sapiens and causing hearing damage.

The main interfaces on the host are distributed on the left and right sides of the host unit. As shown in Figure 2.3

Headphone jack

1. Used for inserting a Φ 3.5mm headphone plug to connect high-fidelity listening headphones. The headphone jack outputs leaked vibrating audio signals.

2. Signal input interface

Used to connect the handle control cable output terminal, interface with sensors, and input leakage vibration signals to the main unit.

3. DCDC charging port

DC5.2*2.1Charging port, used for charging the host device's lithium battery.

2.3 Control handle

The control handle assembly is used to connect the sensor to the host component, as shown in Figure 2.4.

Figure 2.4 Control Handle

When the operator is working, release the handle mute switch, and the headset outputs a leakage vibration audio signal; When the handle mute switch is pressed. The headphones are muted.

	During the movement of the mobile sensor, pressing the mute switch cuts off the signal transmission to the earphones, preventing excessive sound intensity from impacting the auditory senses of the operator homo sapiens and causing hearing damage.

	There are electronic circuits and mechanical structures inside the handle switch, and do not disassemble it without authorization. Otherwise, it may cause damage to the function of the handle. The handle switch is not waterproof and dustproof, please use it in a dry and clean environment. Failure to do so may cause reduced or damaged handle functionality.

2.4sensor

The sensor is placed on the surface of the measured pipeline or buried pipe medium to capture the vibration signals generated by pipeline leakage propagation, as shown in Figure 2.5.

Figure 2.5 Sensor

Bondi-12 is equipped with two sensors, each designed for different usage scenarios. The stylus-type sensor has high sensitivity and should be prioritized during operation, specifically for flat floors or walls, while avoiding contact with wet surfaces. The multi-function sensor is suitable for uneven floors or surfaces with minor water accumulation.

2.5 Headphones

The headset is used to output the leaky vibration audio signal of the main unit. The Bondi-12 is equipped with high-fidelity stereo headphones, as shown in Figure 2.6.

Figure 2.6 Earphones

Headphone speakers are divided into left and right channels. For some people the auditory sensitivity differs between left and right ears, so please wear the headphones according to the marked left (L) and right (R) indicators. Alternatively, you may swap the left and right speaker positions based on actual needs to better complete the audio detection test.

	The actual dynamic range of leaked vibration audio signals is large. Sometimes the output audio signal intensity is very strong, so when conducting listening detection with headphones, special attention must be paid to properly regulating the volume (by adjusting the "sensitivity" button) to avoid damaging the hearing of the detecting Homo sapiens or creating hazards due to inability to hear surrounding sounds.

2 .6 Battery pack and charger

The Bondi-12 pipeline leak detector adopts a high-performance, large-capacity rechargeable lithium-ion battery module and comes equipped with a DC 8.4V charger. As shown in Figure 2.7

Figure 2.7 Charger

The Bondi-12 pipeline leak detector is equipped with a dedicated automatic charging adapter. The charger needs to be plugged into the DC charging port for charging. During charging, the charger indicator light is red, and turns green when fully charged.

	It is recommended not to turn on the main unit's power switch during charging to prevent damage to the instrument or prolong the charging time.

3 Using the Bondi-12 detector

3.1 The connected and installed Bondi-12 pipeline leak detector is shown in Figure 3.1.

Figure 3.1 Installation and Connection of the
Bondi-12 Pipeline Leak Detector

3.2 Inspect before use

Before using the Bondi-12 pipeline leak detector, please ensure the following 3 inspection steps are completed to guarantee the detector achieves optimal working condition during leak detection.

1. Check instrument component connections

Check whether the main unit and accessories are complete; verify the reliability of sensor connections; ensure the shoulder straps are clean, tidy, and sturdy, etc.

2. Check the operation of the instrument

Connect the sensor and headset to the host separately, and then check as follows:

① Turn on the power switch and the LCD screen enters the power-on interface.

② Put on the headset and press or release the mute switch on the handle to check whether there is any sound in the headset.

③ Check whether the effective value of the number in the middle of the working interface and the bar below have changed.

If any issues are detected during inspection, please refer to "5. Troubleshooting" in the latter part of this user manual. If the problem persists, please contact our company.

4 Pressure pipeline leakage detection methods

When buried pressure pipelines experience damages such as trachoma, breakage, or cracks, the pressure difference between the inside and outside of the underground pipeline causes water to jet outward. During this process, the friction between the jetting water flow and the damaged area generates vibrations, the impact of the pressurized jetting water flow on the buried medium induces vibrations, and the swirling of leaking water outside the pipeline creates turbulent noise—collectively referred to as leakage sounds in the general sense.

Despite the assistance of advanced detectors including Bondi-12, since the intensity and spectral distribution (pitch) of leakage sounds are influenced by factors such as internal pipe pressure, burial medium, pipe material, and pipe diameter, determining the exact leakage point during actual detection still requires the extensive practical experience of homo sapiens operators to accurately identify whether it is a leakage vibration signal.

4.1Pipeline leakage sound and characteristics

4.1.1 Leakage sound composition

The composition of sound leakage mainly consists of the following four parts:

(1) Pipeline rupture point friction sound with pressurized water flow;

(2)Vibration sound at the pipeline rupture point;

(3)The impact of the jet water flow on the buried pipe medium generates impact vibration sounds;

(4)The swirling sound of vortex formed by the jet water flow circulating around the damaged area.

The aforementioned sound sources (1) and (2) propagate along the axial direction of the pipeline. Therefore, during actual leak detection processes, if conditions permit, locate the section of pipeline exposed above ground and position the sensor on the pipeline being tested. Examples include the pipeline itself, valves, fire hydrants, etc.

The aforementioned sound sources (3) and (4) propagate outward in the form of spherical wave fronts through the buried pipe medium. Therefore, during actual leak detection, the first step is to determine the approximate alignment of the pipeline buried in the medium. The sensors should be placed directly above the pipeline alignment on the surface of the buried medium and positioned as perpendicular as possible to the wave front.

4.1.2 Sound leakage frequency characteristics

The leakage sound is composed of multiple vibration signals from sound sources, with complex frequency components. It is generally believed that the frequency spectrum range of leakage vibration signals is approximately distributed between 20Hz and 5000Hz, while the mainstream frequency spectrum distribution for common pipeline leaks is around 200Hz to 2000Hz.

The frequency of water leakage sounds output by the leak detector headphones is influenced by the pipe material. Under the same pipe diameter conditions, metal pipes exhibit more high-frequency leakage sound components. Depending on the material — cast iron/steel pipe/copper pipe — the spectrum range of leakage sounds is approximately (400Hz~600Hz) - (1200Hz~3000Hz). Plastic or PVC pipes exhibit more low-frequency leakage components, with a spectrum range of approximately (100Hz~400Hz) - (600Hz~800Hz).

The frequency of water leakage sounds detected by leak detection headphones is influenced by the medium through which the pipeline is buried. Generally, hard and dense media (such as concrete) facilitate sound propagation, resulting in more high-frequency components. Loose and porous media (such as sandy soil, muddy ground, or grassy areas) significantly absorb sound energy, leading to lower-pitched and quieter audible sounds.

4.1.3 Intensity of sound leakage

The intensity of the leakage sound can be simply understood as the volume of the leakage sound. The intensity of the leakage sound output by the headphones of the leak detector is influenced by multiple factors such as the leakage source, water supply pressure, pipe material and diameter, pipe burial medium, and burial depth.

Generally speaking, sounds below 20 decibels are considered quiet; sounds between 20-40 decibels are classified as soft. Sounds in the 40-60 decibel range fall within the normal category. Noise levels above

60-70 decibels are considered loud, while sounds exceeding 80 decibels begin to damage auditory nerves.

The Bondi-12 leak meter adjusts the volume of the headphone output through VOLUME. Adjust the headphone volume to a range that is comfortable for leak detectors (varies from person to person)

4.1.4 Pipeline inspection along the line

When sufficient data is available to indicate the path of the pipeline being inspected, the along-the-pipeline inspection method is employed to achieve leakage detection and localization. The along-the-pipeline inspection method is illustrated in Figure 4.1.

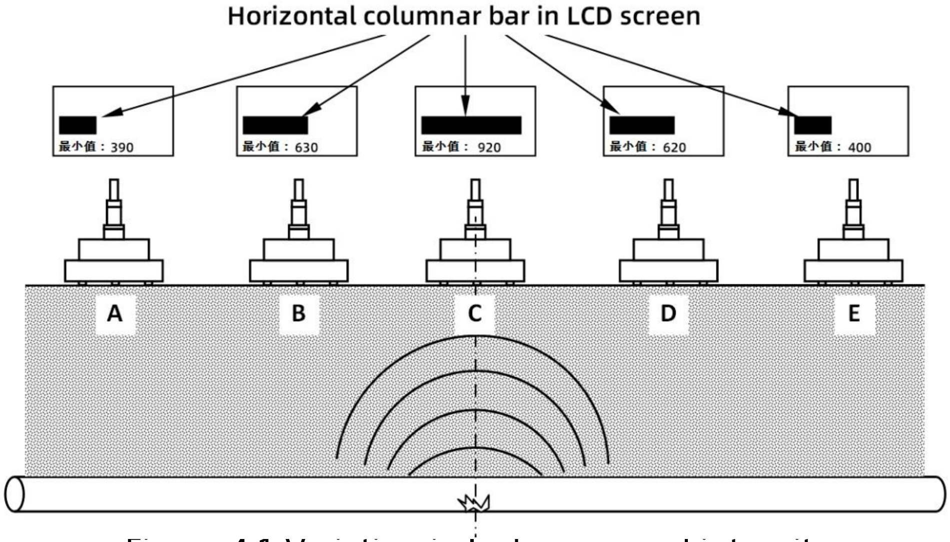

Figure 4.1 Variation in leakage sound intensity along the pipeline during detection

According to the pipeline route, commence detection from any point on the ground surface above the pipeline (such as Point A shown in Figure 4.1.2). The detection method and procedure are as follows:

(1)Place the sensor on the ground directly above the pipeline, such as at point A.

(2)Press the mute control switch on the handle. If there is a leak in the pipeline, a relatively obvious continuous leakage sound will be heard in the headphones. If there is no leak in the pipeline, the sound in the headphones will be very faint, or there will only be random bursts of ambient noise.

(3)Sound detection. Loosen the connection cable between the sensor and the handle, keep the sensor steady and stable, and choose a relatively quiet moment in the surroundings. In addition to carefully distinguishing the volume and frequency of the leakage sound, observe the changes in the horizontal bar graph on the LED, and record the minimum value detected at that point.

(4)Release the handle and move along the pipeline direction in 0.2~1.0 meter steps to other points (such as points B, C, D, E) to repeat steps (1)~(3) above.

(5)Conduct multiple detections around the detection point with the largest minimum value among multiple detection points (such as point C in the figure) to accurately achieve leakage localization.

	When detecting leaks along the pipeline, the selected multiple detection points should ensure that the minimum value undergoes a process of increasing from small to large and decreasing from large to small. If the minimum values of the selected detection points along the pipeline show a gradual decreasing trend, detection points should be chosen in the opposite direction.

4.2 Locating the leakage point

In actual leakage detection, when the pipeline route is unclear or deviates from the documented data, the following two-step method can be employed to achieve leakage localization, as illustrated in Figure 4.2.(1) Start detecting leakage points from the determinable section above the pipeline. For example, in Figure 4.2, begin detection from point A. Proceed step-by-step along the straight line A-B-C from point A to point C. During this process, the leakage sound and minimum values will experience a transition from small to large, then from large to small. The detection point with the largest minimum value in this process is identified as the starting point for the next step of detection, such as point B in Figure 4.2.

(2)Starting from point B, in the direction perpendicular to AC, proceed with the second step of detection along B-D-E. During the second step of detection, the detection point with the maximum leakage sound or the largest minimum value is identified as the leakage point. As shown in point D in Figure 4.2.1.

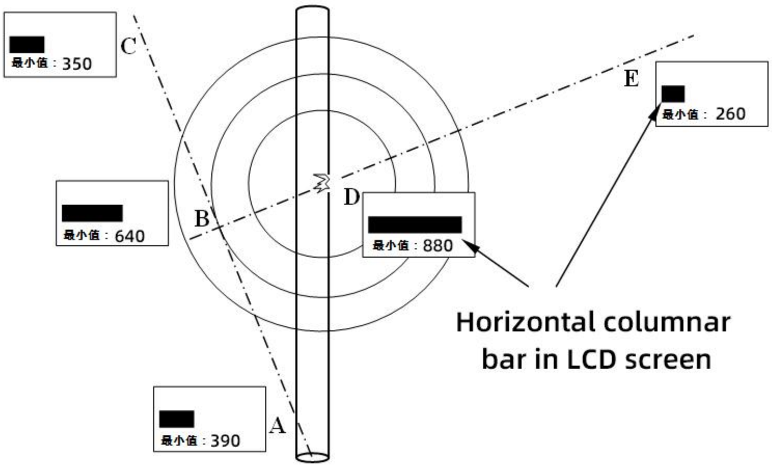

Figure 4.2.1 Two-step method for leak detection and localization

4.3 The impact of dispersion on leakage localization

The vibration signal generated by leakage propagates through various media such as pipe materials and buried layers to the ground, where it is detected and identified by homo sapiens operators to achieve leakage detection. When the leakage vibration signal passes through buried layers of different media, some signal components are absorbed while others are attenuated. Compared to the original leakage signal, the vibration signal ultimately transmitted to the ground exhibits significant changes in loudness and pitch, which is known as the dispersion phenomenon. Dispersion is an objective physical phenomenon, and corresponding countermeasures must be taken during detection.

To address the dispersion phenomenon, the following points should be noted during leakage detection.

First, before conducting leakage detection, carefully understand the ground medium conditions to determine whether the pipeline burial layer is loose or compact and firm. Generally, a loose burial layer significantly attenuates and absorbs high-frequency leakage sounds, while a firm burial layer facilitates the transmission of high-frequency signals. The above judgment helps in selecting the appropriate bandpass filter frequency range before detection.

Secondly, during acoustic detection, in addition to paying attention to the loudness of the sound, special attention should also be given to changes in pitch. If significant pitch variations occur within a small range, it is necessary to conduct multiple repeated detections at that point to determine whether it is a leak, flowing water, or a sudden change in the buried layer.

Due to the complex conditions of the buried layers and other media, near suspected leakage points, slight movement of the sensor may cause the leakage sound or minimum value to suddenly increase or decrease. This could also be caused by dispersion. From another perspective, when the leakage sound or minimum value level bar displays the maximum value observed in the recent period, the sensor may not necessarily be directly above the leakage point, as this depends on factors such as the ground surface and buried layers.

5．Troubleshooting

Fault phenomenon	Reason	Exclusion measures
The instrument cannot be powered on.	Battery power is insufficient.	Charge the instrument
No dynamic light bar displayed on the screen, no sound from the headphones.	The connection between the sensor and the handle cable is unreliable.	Check whether the connector is securely connected.
The earphones are producing a whistling sound.	The sensor and earphones are too close together.	Keep the earphones away from sensors and appropriately reduce the earphone volume.
The device automatically shuts down within a very short time after being powered on.	Insufficient battery voltage	Charge the battery promptly or replace it with a new one.
Garbled characters appear on the LCD page.	Operation error or overshoot	Power off and restart the instrument to restore normal operation.