C-16 Water Leak Detector

User Manual

Shijiazhuang Bondi Technology Co., Ltd

Preface

Dear customers!

Thank you for choosing the C-16 Pipe Leak Detector. If you are using this product for the first time, please read the following product instructions and usage guidance carefully.

The C-16 User Manual explains in detail the components, functions, operating procedures, precautions, and methods of using the C-16 Pipeline Leak Detector for pipeline inspection and leak location. Please be sure to read and fully understand the contents of the manual before operating or using the C-16 Pipe Leak Detector. If you have any questions about the operation and use of the C-16, please feel free to call us and we will provide you with prompt and dedicated technical support and service. Thank you for your cooperation!

Please keep the manual in a safe place so that you can refer to it when necessary, and if the manual is lost or damaged, please contact us immediately.

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1 Echnical Parameters

The technical parameters of the C16 pipeline leak detector are shown in Table 1.1, Table 1.2 and Table 1.3

Table 1.1 Sensor specifications

Type	Piezoelectric type
Mode	Survey mode and location mode
Dimensions	Diameter 78mm, height 50mm (excluding connecting wires)
Weight	400g

Table 1.2 Host Technical Parameters

Magnification	100db
Frequency range	100-6500Hz
Power supply	Lithium battery 16.8V 5000mah, supporting charger
Operating temperature range	-20℃~+55℃
Working hours	≥36 小时
Display screen	LED Digital tubes
Connect the terminals	Power switch X1 Sensor connector X1 3.5mm Headphone jack X1 DC5.5*2.1 Charging socket X1

Filter	100-6500Hz（Adjustable）
Probing depth	3m
Size	184mm×138mm×80mm
Weight	900g

Table 1.3 Headset technical parameters

Playback method	Surround sound
How it works	Fully enclosed monitor headphones
Horn diameter	40mm
Frequency of response	20Hz-22KHz
Impedance	32Ω

2 Instrument composition

The C-16 Pipeline Leak Detector consists of a host unit and a software system.

The C-16 Pipeline Leak Detector Unit includes a sensor and control handle for acquiring leakage signals, a host unit for leakage signal processing and information display, and a hi-fi headset for hearing and identifying leakage status. When the host system inspects or locates the leakage, the control status information of the leak detection is displayed in the form of sound and digital tube through the LED digital tube and earphone on the host panel.

2.1 Product Composition

The product composition of the C-16 Pipeline Leak Detector is shown in Table 2.1.

Table 2.1 Component composition of the detector

1 piece of host unit	1 multi-function sensor	1 indoor sensor
		
1 piece of handle	1 piece of headphones	Charger 1 pc
		
1 piece of host package	1 instrument case	1 instrument Grass probe
		

2.2 Host unit composition

The host unit is the main component of the detector, including the host (including power supply, main interface, LED digital tube, etc.), control handle and sensor, earphone, battery pack and charger. This section will elaborate on the distribution function, specifications, performance, and connection methods of the host unit composition.

2.2.1 Hosts

2.2.2 LED digital tube display area

The LED display area is located in the middle of the front panel of the detector, as shown in Figure 2.2.

Figure 2.2 LED digital tube display

The LED digital tube is used to display the leakage sound size beam of light, filter control information, and host status information.

The intensity of the leakage sound is related to the level and brightness of the LED digital tube. The higher the LED digital tube display, the stronger the brightness, the greater the intensity of the leakage sound.

2.2.3 3 Operation Panel

The operator panel is distributed around the LED digital tube, as

shown in Figure 2.3.

Figure 2.3 Operation interface

POWER OFF

It is used to switch the power on and off and adjust the volume, and the volume is according to the operator's acceptance range. Turn off the power when you're done using it, and turn it to the left until it clicks when the power is off.

	Check the power status after powering on/off to prevent abnormalities.

FILTER

Users can select the filter channel range to detect leakage signals according to actual needs to meet the leakage detection needs of different materials/pipe diameters and different working sections (buried media).

Filter	100-6500Hz	Recommendation: [D-E] for outdoor small pipe inspection
		Recommendation: [C-D] for outdoor large pipe inspection

Note: The adjustment of the filter is adjusted by the operator according to the site conditions.

Meter Sens

It is used to adjust the sensitivity of the LED, and the normal adjustment can be adjusted to 5, and the appropriate adjustment can find the leakage point more accurately.

Note: The adjustment of the LED is adjusted by the operator according to the site conditions.

BATTERY

The LED indicator used to indicate the battery power status, the LED indicator is red when the power is turned on, and the signal input between the host and the handle is connected, and the LED indicator is green, indicating that the battery is sufficient. When the battery is depleted, it will turn from green to red, please charge the device in time when the LED indicator shows red.

2.2.4 4 Main interfaces

The main interfaces on the host are distributed on the left and right sides of the host unit. This is shown in Figure 2.4。

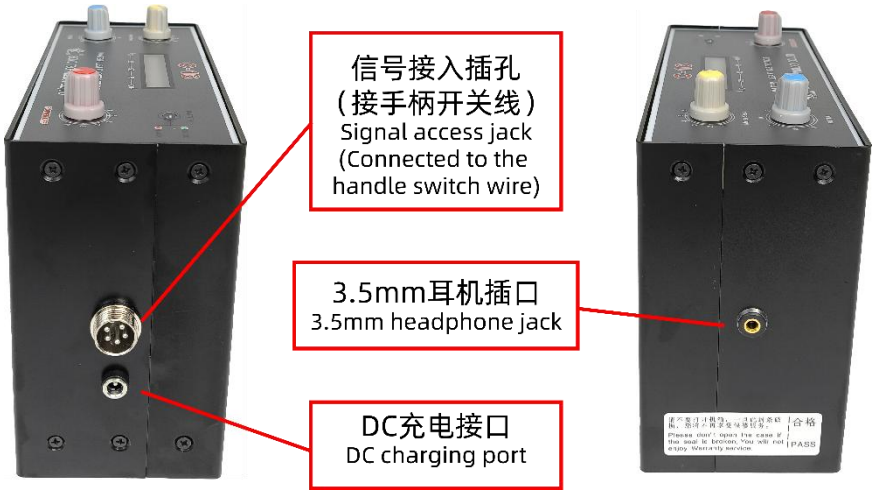

Figure 2.4 Main Interfaces

1. Headphone jack

It is used to plug in the Φ3.5mm headphone plug and connect the high-fidelity listening headphones. This headphone jack outputs a leaky

vibrating audio signal.

2. Signal input interface

It is used to connect the output terminal of the handle control cable, connect the sensor, and input the leakage vibration signal to the main machine.

3. DC charging jack

DC5.2*2.1 charging socket, used to charge the host lithium battery

2.2.5 5 Control Handles

The control handle assembly is used to connect the sensor to the host assembly, as shown in Figure 2.5.

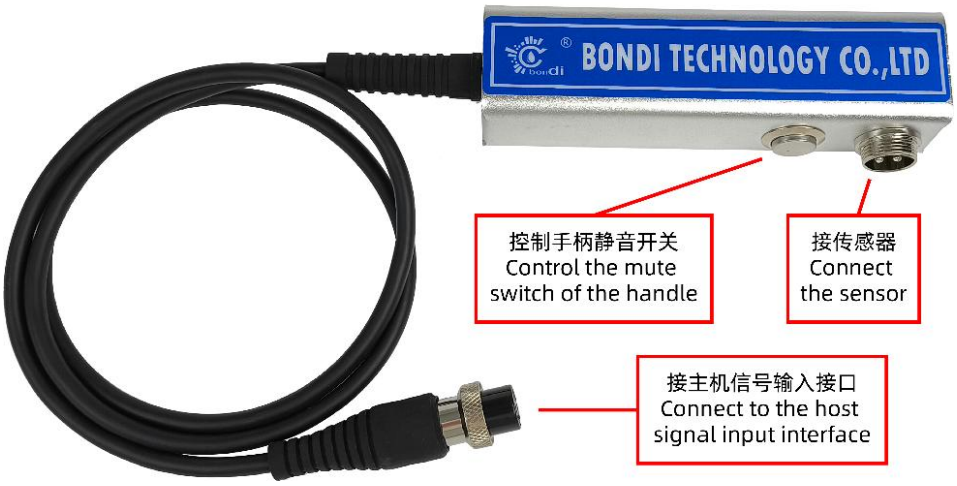

Figure 2.5 Control handles

The operator presses the mute switch to turn on the earphone signal channel during the detection, and the earphone output leaks a vibrating audio signal at this time; When the mute switch of the handle is released, the switch will return naturally. At this time, the earbuds are muted and there is no audio signal output.

	Release the mute switch during the movement of the sensor to cut off the signal transmission to the headphones, preventing excessive sound intensity from impacting the operator's hearing and causing hearing damage.

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

2.2.6 6 Sensors

The sensor is placed on the surface of the pipeline and buried pipe medium to obtain the vibration signal propagated by the pipeline leakage, as shown in Figure 2.6.

Figure 2.6 Sensors

The structure of the sensor adopts the buffer connection between the sensitive parts and the shell, which can effectively reduce the interference noise caused by the shaking of the connecting cable and environmental disturbance. In order to meet the needs of the different frequency responses of the sensors for inspection and positioning in the actual leak detection process, we are equipped with two sensors.

	The position and orientation of the sensor have a great influence on the detection effect. The results show that the direction of the center line of the symmetry axis of the sensor is consistent with the radial direction of the leaking pipe, and the detection effect is the best.

2.2.7 7 Headphones

The headset is used to output the leakage vibrating audio signal of the main unit. The C-16 is equipped with a high-fidelity stereo headset, as shown in Figure 2.7。

Figure 2.7 Headphones

There is a right and left side of the headphone speaker. For some people, the sensitivity of the left and right ears to sound is different, so please wear the earphones according to the left (L) and right (R) marked on the earphones. You can also change the order of the left and right speakers according to the actual situation to better complete the listening detection.

	The dynamic range of the actual leakage vibrating audio signal is large. Sometimes the output audio signal is very strong, so when wearing headphones for hearing detection, pay special attention to adjusting the volume (by adjusting the "sensitivity" knob) to avoid damaging the hearing of the inspector or causing danger due to the inability to hear the surrounding sounds.

2 2.2.8 8 Battery pack with charger

The C-16 Pipeline Leak Detector features a high-performance, high-capacity rechargeable lithium-ion battery assembly and is equipped with a DC16.8V charger. This is shown in Figure 2.8.

Figure 2.8 Charger

The C-16 Pipe Leak Detector is equipped with a dedicated automatic charging adapter, and the charger needs to be plugged into the DC charging socket to charge.

When in use, when the battery indicator is red, it means the battery level, please charge the device in time. In order to prevent damage to the battery due to over-discharge, corresponding protection circuits are set inside the instrument and battery components to ensure that the instrument can automatically shut down before the battery is about to be exhausted, and the instrument can continue to be used after charging.

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

3 Use the C-16 tester

3.1 Install the C-16 tester

1. Remove the main unit, cable with control handle, sensor, and headset from the instrument case.

2. Connect the end with the control handle cable to the sensor.

3. Connect the other end with the control handle cable to the console.

4. Insert the earphone plug into the earphone jack on the side of the host to enable the headset to receive the audio signal output from the host computer.

5. Adjust the length of the connecting cable to meet the needs of leak detectors to facilitate the extraction of sensors; Adjust the main strap to make it easy and comfortable to carry during inspection.

The C-16 Pipe Leak Detector is connected and installed as shown in Figure 3.1.

Figure 3.1 Installation and connection of C-16 pipeline leak detector

3.2 Check before use

Please make sure to do the following 3 checks before using the C-16 Pipeline Leak Detector to ensure that the detector is in optimal working

condition during leak detection.

1. Check the instrument parts connection

Check whether the main unit and accessories and other parts are complete; whether the sensor connection is reliable; Whether the shoulder straps are clean and sturdy and reliable, etc.

2. Check the battery level

Before starting to use this instrument, be sure to check the battery level to ensure that the battery level of the instrument is sufficient. The way to check the battery level is to connect the main unit with the handle, turn on the power, and the LED battery indicator of the main unit is green, indicating that the battery is sufficient. The LED battery indicator is red, indicating that the battery is low.

3. Check the operation of the instrument

Connect the sensor and headset to the console separately and check as follows:

1. Turn on the power switch and the battery indicator is green.
2. Press the handle and put on the headphones to check if there is any sound in the headphones.
3. Press the handle to check if there is any change in the LED digital tube.

If any problems are found during the inspection, please check the back of this instruction manual "5. Troubleshooting", if there are still problems that cannot be solved, please contact the company.

4 Pressure Pipeline Leak Detection Method

Trachoma, damage, cracks and other damage occur in the buried pressure pipeline, and there is a pressure difference between the inside and outside of the pipeline due to the pressure inside the underground pipeline, resulting in the water flow spraying outward. In this process, the jet water flow rubs against the damaged part and causes vibration at the damaged part, the pressure jet water flow impacts the buried pipe medium to produce vibration, and the leaking water flow whirls outside the pipeline to produce turbulent sound.

Despite the help of advanced detectors, including the C-16, the

intensity and spectral distribution (tone) of the leakage sound are affected by factors such as the pressure in the pipe, the buried medium, the material of the pipe, the diameter of the pipe, etc., so the actual leak detection process requires the inspector's rich practical experience to accurately determine whether it is a leak vibration signal.

4.1 Pipeline leakage sound and characteristics

4.1.1 1 Leakage sound composition

There are 4 main components of leaked sound:

(1) The sound of friction between the broken part of the pipeline and the pressure water flow;

(2) Vibration sound at the damaged part of the pipeline;

(3) The jet water flow impacts the buried pipe medium to produce impact vibration sound;

(4) The sound of a vortex formed by a jet of water swirling around the breakage.

The above sources (1) and (2) propagate along the pipeline axis. Therefore, during the actual leak detection process, if conditions permit, find the pipe that is exposed to the ground and place the sensor on the pipe to be measured. Such as the pipes themselves, valves, fire hydrants, etc.

The above-mentioned (3) and (4) sound sources propagate outward in the buried tube medium with spherical wave oscillators. Therefore, in the actual leak detection process, the general direction of the pipe buried in the medium is first found. Place the sensor on the surface of the buried pipe medium directly above the pipe direction. and try to be perpendicular to the wavefront.

4.1.2 2 Leakage Sound Frequency characteristics

Leakage sound is composed of vibration signals from multiple sound sources, and the frequency composition is complex. It is generally believed that the spectrum range of leakage vibration signals is about 20Hz-5000Hz, and the mainstream spectrum distribution of common pipeline leaks is about 200Hz-2000Hz.

The frequency of the leakage sound output from the earphones is affected by the material of the pipe. Under the condition of the same

pipe diameter, the high-frequency leakage sound component of the metal pipe is more, and the sound spectrum range of water leakage is about (400Hz~600Hz)-(1200Hz~3000Hz) according to different materials such as cast iron/steel pipe/copper pipe. Plastic or PVC pipes have more low-frequency leakage components, and the spectrum range is about (100Hz~400Hz)-(600Hz~800Hz).

The frequency of the water leakage sound output by the earphones of the auditory leak meter is affected by the buried medium of the pipeline. Generally speaking, a hard and solid medium (such as concrete) is conducive to sound propagation, and there are many high-frequency components. Loose media with voids (such as sand, mud, grass, etc.) have an obvious effect on the absorption of sound energy, and the sound heard is low and the volume is low.

4.1.3 3 The intensity of the leaking sound

The intensity of the leaked sound can be simply understood as the volume of the leaked sound. The intensity of the leakage sound output of the earphone is affected by many factors such as leakage source, water supply pressure, pipe diameter, buried pipe medium, buried pipe depth, etc.

In general, sounds below 20 decibels are considered quiet; The sound of 20-40 decibels is soft. A sound of 40-60 decibels is normal. Sounds above 60-70 decibels are considered noisy, and sounds above 80 decibels begin to damage the hearing nerve.

The C-16 Leak Meter is used to adjust the volume output of the headphones through the volume adjustment knob. Depending on the situation, adjust the headphone volume to a range that is more comfortable for the leak detector (this will vary from person to person).

4.2 2 Detection along the pipeline

When there is sufficient data to point out the direction of the tested pipeline, the method of detection along the pipeline is used to realize leakage detection and positioning. The method of inspection along the pipeline is shown in Figure 4.1

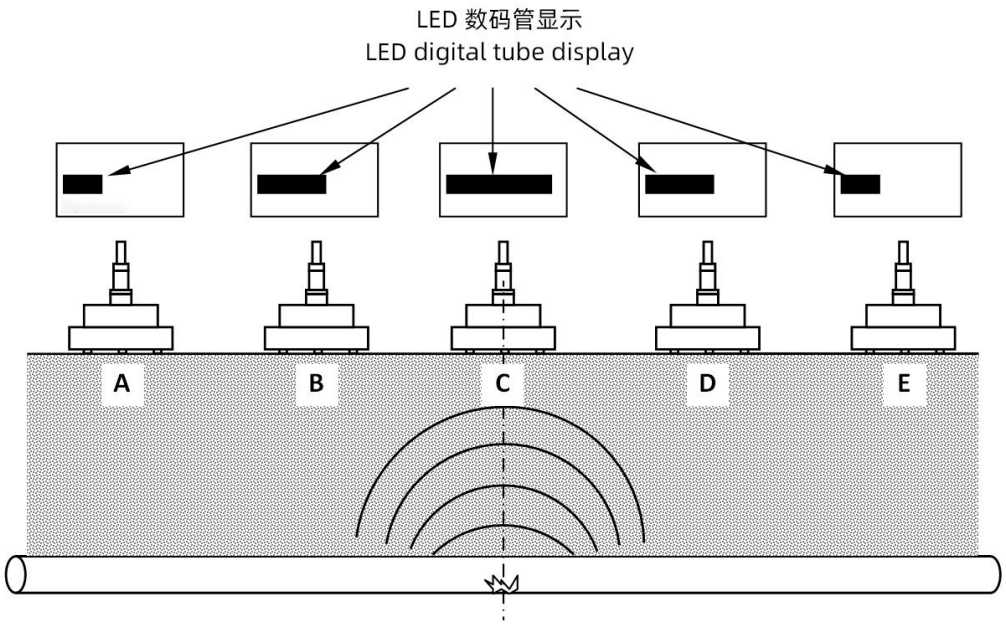

Figure 4.1 Changes in the magnitude of leakage during inspection along the pipeline

Depending on the route of the pipeline, the inspection is initiated from any point in the ground above the pipeline, as shown at point A in Figure 4.1. The detection method and process are as follows:

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

(2) Press the mute control switch of the handle. If there is a leak in the pipe, there will be a more noticeable continuous leakage sound in the headphones. If there are no leaks in the pipes, there is little sound in the headphones, or only random bursts of sound in the surroundings.

(3) Hearing detection. Loosen the connection line between the sensor and the handle, keep the sensor fixed and stable, choose a moment of relative calm around you, and observe the change of the horizontal bar in the LED while carefully discerning the volume of the leaked sound, the audio, and remember the minimum value detected at that point.

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

(5) Perform multiple inspections around the detection point with the largest minimum value among multiple detection points (as shown in the figure point C) to accurately locate the leak.

	When detecting leaks along a pipeline, multiple detection points should be selected so that the minimum value goes through a process of changing from small to large and from large to small. If the minimum value of the inspection point selected along the pipeline appears to be progressively smaller, the inspection point should be selected in the opposite direction.

4.3 3 Locate the leak point

In the actual leak detection, if the pipeline direction is unclear or the pipeline direction deviates from the data, the following two-step method can be used to locate the leak, which is shown in Figure 4.2.

(1) Detect the leak point from above the pipeline that can be determined. For example, in Figure 4.2, the detection starts at point A. Point C is gradually detected along the straight line A-B-C starting from point A, and the leakage listening and minimum will go through a process from small to large and from large to small. The detection point with the largest minimum value in this process is determined as the starting point for the next test, as shown at point B in Figure 4.2.

(2) Start the second step of detection from point B, perpendicular to the direction of AC, along B-D-E. In the second step of detection, the detection point with the largest or minimum leakage is determined as the leak point. See point D in Figure 4.2.

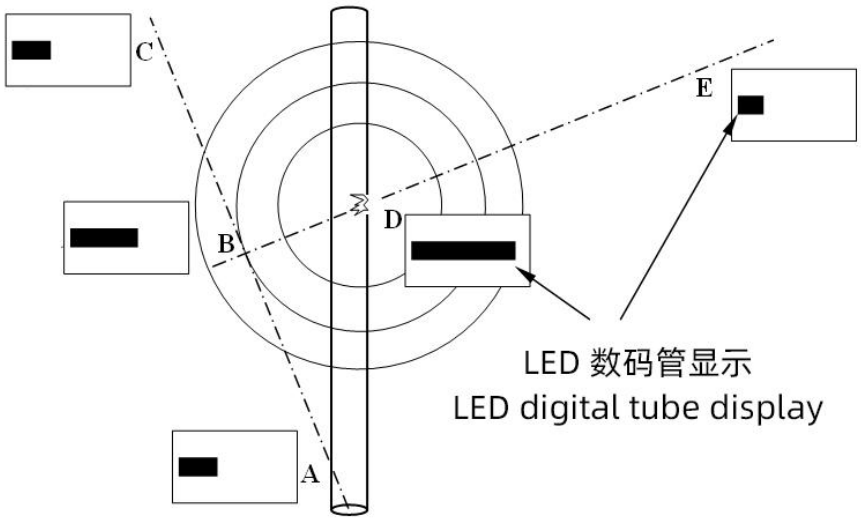

Figure 4.2 Two-step method to achieve leak detection and positioning

4.4 4 Effect of dispersion on leak location

The vibration signal generated by the leakage is transmitted to the ground through various media such as pipes and buried layers, and is detected and identified by the inspector through the sensor to achieve leak detection. When the leakage vibration signal passes through the buried layer of different media, some of the signal components are absorbed and some are attenuated. The vibration signal that is eventually transmitted to the ground has a large change in loudness and tone compared with the leakage signal, which is the phenomenon of dispersion. Dispersion is an objective physical phenomenon, and corresponding countermeasures need to be taken to detect it.

In view of the dispersion phenomenon, the following points should be paid attention to when leak detection.

First, carefully understand the condition of the media on the ground before leak detection to determine whether the buried layer of the pipeline is soft or tight and firm. Generally speaking, the attenuation and absorption of leakage high-frequency sound by the soft buried layer are obvious, and the solid buried layer is conducive to the transmission of high-frequency signals. The above judgment helps to select the appropriate bandpass filter band before detection.

Secondly, in addition to paying attention to the loudness of the sound, special attention should be paid to the change in the pitch of the voice when listening to the sound. If the change in pitch is noticeable over a small area, the test site needs to be tested multiple times to determine whether it is a leak or running water, or a sudden change in the buried layer.

Due to the complex conditions of media such as buried layers, near the suspected leak point, there may be a slight movement of the sensor, and the leakage sound or minimum value will suddenly become loud/small. This can also be due to dispersion. On the other hand, when the leakage sound or minimum level bar is shown as the maximum value in the recent period, the sensor is not necessarily directly above the leak point, depending on the ground, buried layer, etc.

5 Troubleshooting

Fault phenomenon	cause	Exclusions
The instrument cannot be turned on	The battery is low.	Charge the instrument
There is no dynamic light bar display on the screen	The connection between the sensor and the handle cable is unreliable.	Check that the connector is connected reliably
The headphones are silent	The sensor and the headset are too close together	Keep the headphones away from the sensor and lower the headphone volume appropriately
The headphones whine	The battery voltage is insufficient	Charge the battery in time or replace it with a new one