USER MANUAL

Cable & Pipe Locator

LKZ-1000

v2.2 4.03.2020

Introduction

Purchase

Congratulations on your purchase of a LKZ-1000 instrument

This manual contains important safety directions as well as instructions for setting up the product and operating it. Refer to "9 Safety Directions" for further information.Read carefully through the User Manual before you switch on the product.

Product identification

The serial numbers of your products are indicated on the type plate. Enter the serial numbers in your manual and always refer to this information when you need to contact your agency or Sonel S.A. authorised service workshop.

Serial No. LKO-1000:   _____
        LKN-1000:   _____
        Conductive Rod: _____
        Signal Clamp N-2: _____
        Connection Set AS-1: _____
        Sonde NAD-1: _____

Symbols

The symbols used in this manual have the following meanings:

Type	Description
⚠ **Danger**	Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.
⚠ **Warning**	Indicates a potentially hazardous situation or an unintended use which, if not avoided, could result in death or serious injury.
⚠ **Caution**	Indicates a potentially hazardous situation or an unintended use which, if not avoided, may result in minor or moderate injury and/or appreciable material, financial and environmental damage.
☞	Important paragraphs which must be adhered to in practice as they enable the product to be used in a technically correct and efficient manner.

Validity of this manual

This manual applies to Sonel locator and transmitter instruments LKO-1000 and LKN-1000 and accessories. Differences between the various instruments and models are marked and described.

Table of Contents

1.   General Information

1.1   How to use this manual

☞   It is recommended to set up the product while reading through this manual.

Index   The index is at the back of the manual.

Instrument label   On the Locator and Transmitter you will find a label that shows some important information by means of illustrations. You will find some of these illustrations in this manual too. This should help to get a clear connection between the instrument label and the informa-tion in this manual.

Description

Locators are used to detect buried conductive services emitting an electromagnetic signal which is generated by a current passing through the service.

Transmitters are used to apply a distinct signal to conductive services, which may not radiate electromagnetic signals or may need to be traced for a specific purpose.The Transmitter is required to make a depth measurement.

The Locators and Transmitters described within this manual will greatly increase the detection process and help to reduce the dangers and costs associated with service strikes. But the very nature of electromagnetic location is dependent on the services being conductive (metallic) and radiating a signal as current flows through them.

It is important to remember that a Locator on its own will not detect all services and care should be taken when excavating. It is generally accepted that a safe system of work should be adopted which would include planning the work in advance, the use of utility maps, the use of Locators and Transmitters, and the use of safe digging practices.

⚠ **Caution**

The absence of a positive indication does not guarantee the non-existence of a service. Services without a detectable signal may be present.

The Locators can only locate non-metallic services such as plastic pipes, typically used by the water and gas utilities, with the use of appropriate accessories.

Precautions:
Always excavate with care.

Accessories	Designed to increase the detection of services with no (or little) signals on them. Generally work in conjunction with the Locator and Transmitter.
Functional Check	Designed to demonstrate the equipment is working satisfactorily in between service intervals. Refer to "Appendix A Functional Checks" for more information.

1.3 Instruments and Accessories

General information

This is a collection of products used to locate buried metallic and nonmetallic services.

a) Locator LKO-1000 **(WMGBLKO1000)**
b) Transmitter LKN-1000 **(WMGBLKN1000)**
c) Case L-6 **(WAFUTL6)**
d) Earth contact pin probe **(WASONG15)**

Instruments Overview

a   b   c   d
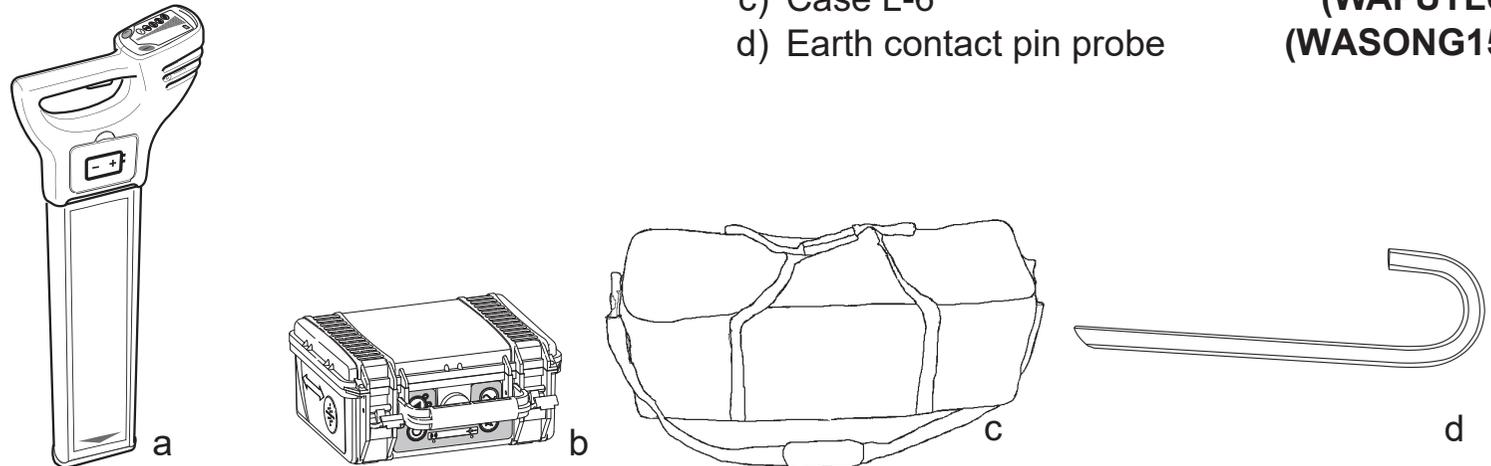
Accessories Overview

a b   c   d
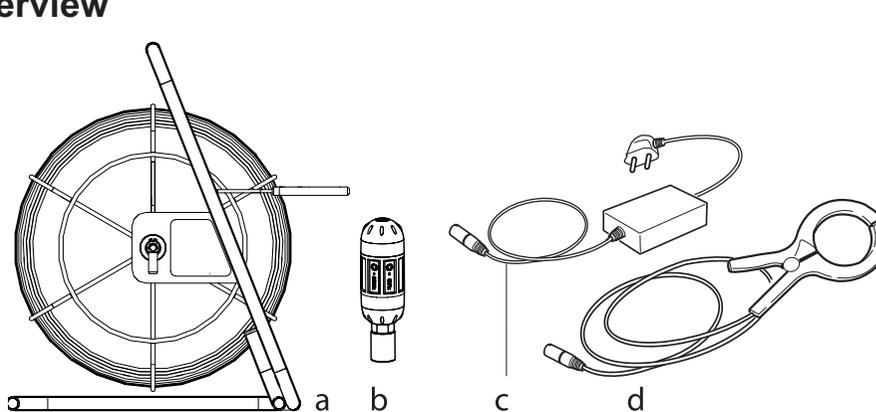
a) Conductive Rod (non metallic service tracer):
   -30m **(WAPRZPN30)**
   -50m **(WAPRZPN50)**
   -80m **(WAPRZPN80)**
b) Sonde NAD-1 **(WASONNAD1)**
c) Property Connection Set AS-1
   Europe („French") standard **(WAADAAS1PL)**
   Switzerland standard **(WAADAAS1CH)**
   US standard **(WAADAAS1US)**
   Australia standard **(WAADAAS1AU)**
d) Signal Clamp N-2 **(WACEGN2)**

2. How to Use the Locator

2.1 General Information

|	
Operating Modes	• Passive modes (Power and Radio) • Active modes (8kHz and 33kHz) • Auto mode (Combined Power and Radio modes)
Electromagnetic signals	An electromagnetic signal radiates from buried conductive services as an electrical current flows through them. The Locator processes these signals and displays their presence.
Passive signals	Some signals are already present on buried services and can be readily detected by the Locator. We call these passive signals. These signals are generated by power distribution systems and radio transmitters.
Active tracing	Some conductive services do not emit passive signals. These services may be traced by applying a signal to the service by using a transmitter.
Depth indication	Depth indication is only available with the Locator when used in conjunction with the Transmitter or Sonde. The displayed depth is to the centre of the service or to the Sonde.
Hazard zone	Provides an additional alarm, indicating the close proximity of a service emitting a Power, 8kHz or 33kHz signal.
Peak hold	Assists in pinpointing a service by displaying the peak reading for a short period of time.

2.2   LKO-1000 Locator Overview

Locator main parts
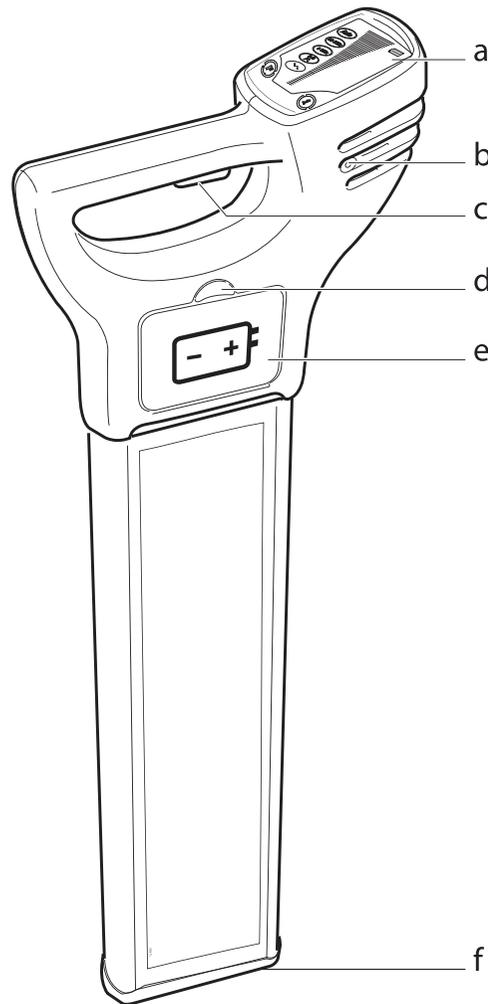
a) Display Panel
   Contains the operational controls.
b) Speakers (mounted internally left and right)
   Active at power on and when a signal is detected.
c) On/Off Trigger
   Press and hold the trigger to activate the Locator.
   Release the trigger to deactivate.
d) Battery Hatch Release
   Pressing the yellow release button unlocks the battery
   hatch allowing access to the battery compartment.
e) Battery Compartment
   6 x LR6 (AA) alkaline batteries are used. Replace all
   batteries when indicated.
f) Case Foot

☞ The case foot can be replaced if it is worn. Contact your agency or Sonel S.A. authorised service workshop.

Display panel overview

a) Signal Strength Indicator
Indicates the response of the Locator to a signal (service).
b) Mode Indicators
Displays the selected mode: Power, Radio, 8kHz, 33kHz, Auto (as shown, from bottom to top).
c) Function Button
Selects operating mode.
d) Light Sensor
Automatically switches the displays backlight on or off to suit light conditions.
e) Battery Indicator
Indicates the battery condition. Segment illumina-tion decreases as battery condition declines. Replace the batteries when the battery indicator is empty.
f) „i" Button
Used to access the user settings and to provide a depth readout.
g) Wrench
Indicates that the Locator requires periodic service.
It is recommended to perform periodic calibration of the device every 12 months.
h) Measurement Unit
Indicates depth indication is in metric or feet and inches.
i) Display Readout
Alpha numeric matrix indicates system set up and depth indication.
j) Depth Mode Indicators
Indicates a depth reading to a service or a Sonde. Service depth icon used to indicate 'Hazard Zone' status.
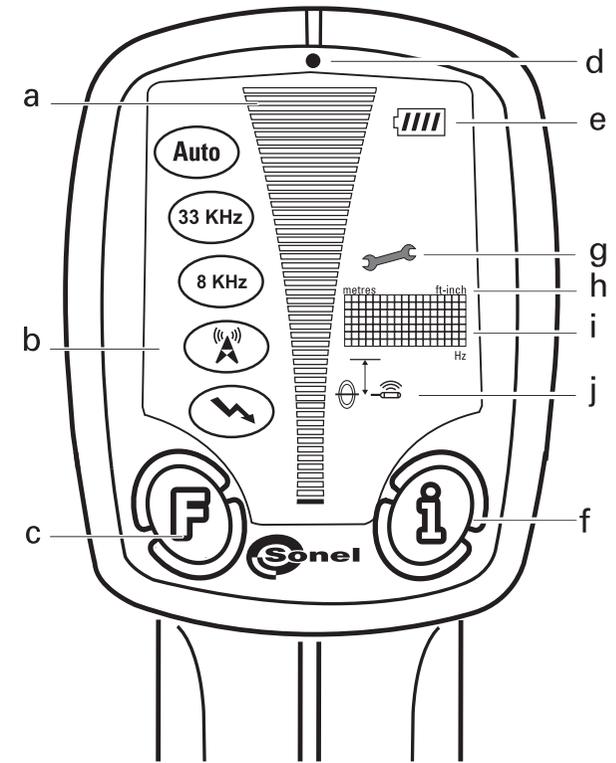
2.3   Locator Setup and Information

The Locators offer a range of settings which the operator can adjust to their own preference. It also displays additional service and contact information as detailed

Setting	Description
EST	Performs a function check on the locators hardware and software, displaying PAS if the Locator is within predefined tolerance or ERR if the locator it is not.
H.Z	Switches 'Hazard Zone' on or off.
VOL	Adjust volume level (0 - 10).
HLD	Adjust peak hold duration (0 - 5 seconds).
SSI	Displays a numeric signal strength indicator.
CST	Adjusts display's contrast (0 - 15).
M/I	Displays unit of measurement.
CAL	Displays the next service date DD/MM/YY.
TEL	Displays supplier/company telephone number.
I.D.	Displays the operator's name.
PWR	Displays the power mode regional setting. Refer to "Appendix B World Frequency Zones" for more information.
SR#	Displays unit serial number.
VER	Displays software version
CLK	Displays the date held within the locators memory. Format DD/MM/YY/HH/MM/SS

Accessing and adjusting the settings

1. Switch the Locator on.
2. Ensure the Locator is in Power mode. If required, press Function Button to select mode.
3. Depress „i" Button for 2 seconds. The user settings will be displayed in the display readout.
4. Press Function Button to toggle through to desired setting.
5. Press „i" Button to select the setting.
6. Press Function Button to activate/adjust.
7. Press „i" Button to store and exit.

⚠ **Danger**

The Locator may fail to detect electrical services in Power mode if an incorrect power setting is used.

Precautions:

Before use, verify the Locator is setup to be compatible with mains frequency supply in your country. Options are 50 or 60Hz. Refer to Appendix B „World Frequency Zones" for more information.

Contact your agency or Sonel S.A. authorised service workshop if your unit is incorrectly configured for your region.

Changing the battery

1. Replace or recharge the batteries when the battery status indicator is empty.
2. Press the release button to unlock the Battery Hatch. Remove the battery holder from the Locator.
3. Replace all batteries with six new LR6(AA) batteries, or remove and recharge the battery pack if rechargeable batteries are fitted.

Alkaline batteries should be used.

6x LR6 (AA)
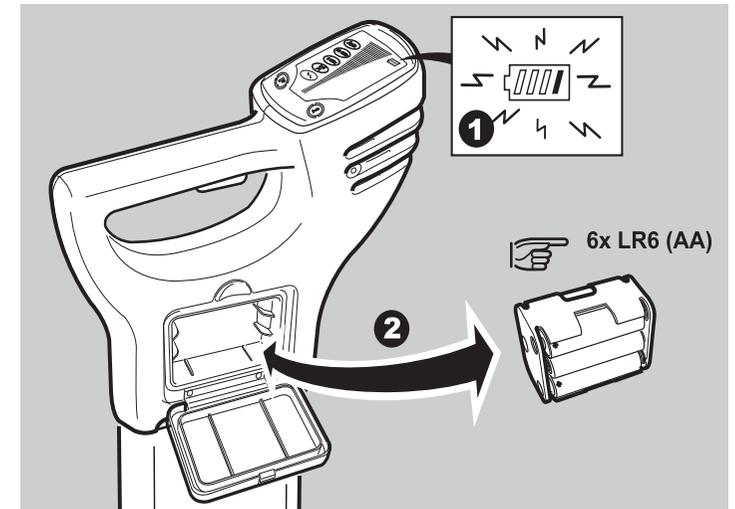
2.4　　　　　　　　　**Hazard Zone**

Description

Provides an additional warning to the close proximity of buried services and functions in the following modes:
• Power
• 8 kHz
• 33 kHz
• Auto mode (Power mode only)

Hazard zone status indicators

Status Indicator	Description
	Hazard zone is switched on.
	Hazard zone on and is alarming.
	Hazard zone is switched off.
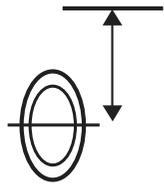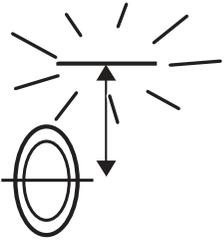
⚠️ **Caution**

The absence of a positive indication does not guarantee the non-existence of a service. Services without a detectable signal may be present. The Locators can only locate non-metallic services such as plastic pipes, typically used by the water and gas utilities, with the use of appropriate accessories.
Precautions:
Always excavate with care.

2.5 How to Locate a Service

Start up test

The following test sequence will take place every time the Locator is activated.

On test	Test pattern	Info on label
Audio Output	On throughout test sequence	
Signal Strength indicator	Scrolls through in sequence once	
Mode indicators	Briefly illuminated	
Battery indicator	On throughout	
Measurement unit, display readout, depth mode indicator	Briefly illuminated	
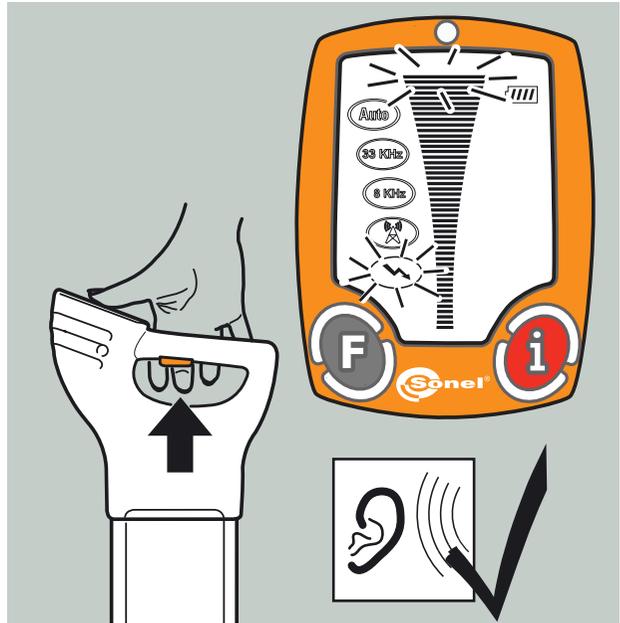
The unit will then go into Power mode maximum sensitivity.

Locating process

The locating process is split into three steps:
• Sweep Search
• Pinpointing the service
• Direction of the service

Sweep Search

The unit will automatically select Power mode and maximum sensitivity

Auto mode combines the benefit of simultaneous detection in Power and Radio modes and helps to confirm the presence of services upon initial site occupation. Improved defi-nition of the service will be provided by single mode operation.

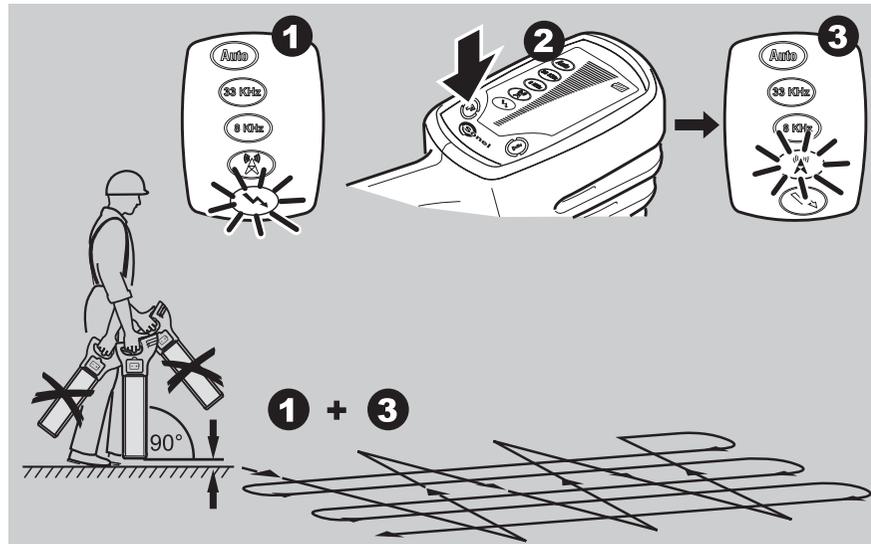1. Define the area to be excavated.

2. In Power mode cross the site from left to right keeping the Locator LKO-1000 upright, taking care not to swing the unit. Turn through 90 degrees and repeat.
   Ensure that the Locator is held in an upright position and close to the ground.

3. Continue the sweep until either a signal is located or you are satisfied that the area has been adequately tested.

   In the presence of a service emitting a traceable signal a tone will be emitted and the signal strength indicator will rise and fall as you pass over it.

4. Repeat the Sweep Search process in Radio mode.
   The Sweep Search must be conducted in Power and Radio modes as a minimum, as not all services (including some electrical ones) emit a power signal. These services may be found using Radio mode or active modes.

☞ Hazard zone can be operated in Power, 8kHz, 33kHz and Auto modes and provides an additional alarm to the presence of buried services which may be within close proximity.

Pinpointing the service
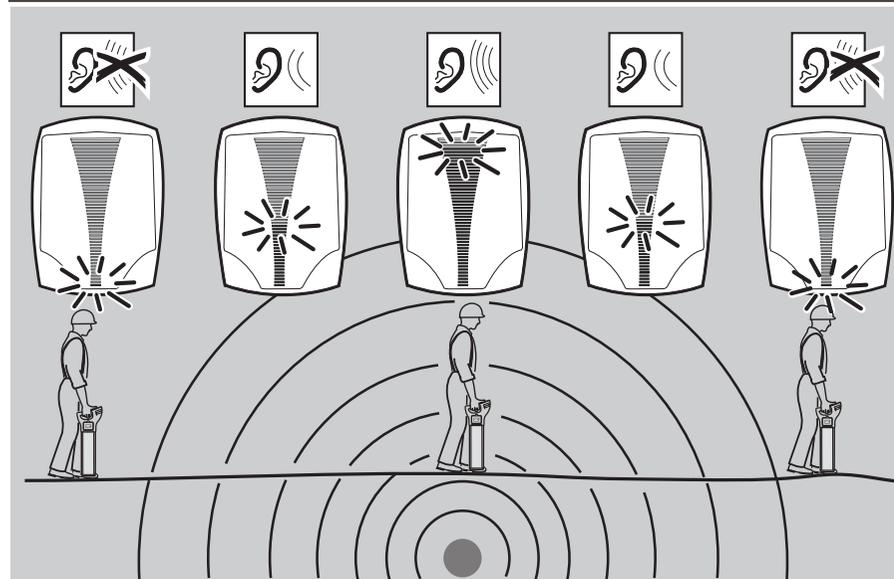
Retrace your steps to the area where the highest signal reading (peak response) was obtained. The service is directly below the Locator when the signal strength indicator is at its maximum. The audio output will automatically adjust to facilitate pinpointing over the service, and automati-cally reset when the signal strength indicator drops to its minimum position.

☞
- Always use chalk or paint to mark services, never pegs.
- The signal strength indicator does not indicate the size, depth or type of a service.

Peak hold
When activated peak hold will show the highest peak reading obtained during the pinpoint process. The displayed reading can be adjusted between 0 to 5 seconds.

**Detecting direction of
the service**
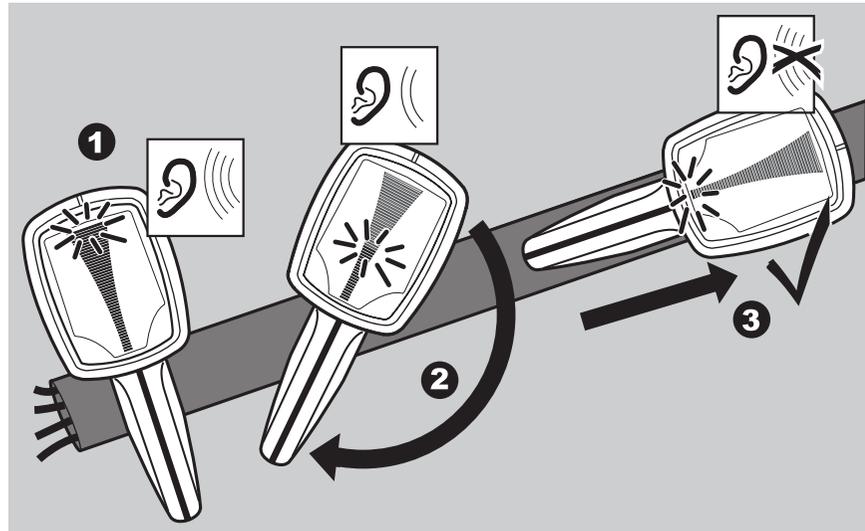
1. Position the Locator directly over
   the service.
2. Rotate the Locator on its axis.
3. The blade of the Locator will be in
   line with the service when the
   signal strength indicator is at its
   minimum.

Depth Indication
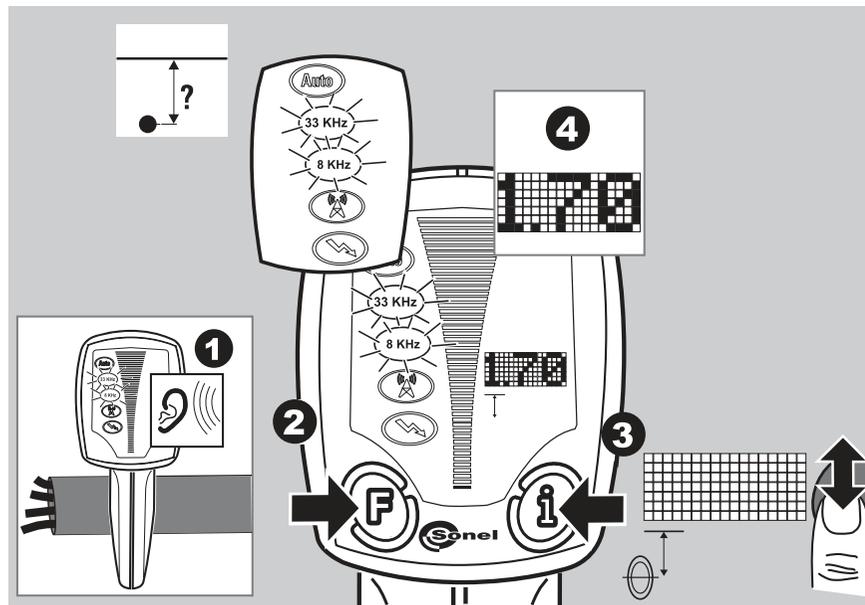
1. Apply a signal to the service.
   Refer to Chapter 3 "How to Use
   the Transmitter" for more
   information.
2. Select either 33kHz or 8kHz
   modes to suit the the Trans-
   mitter's output. Position the
   Locator directly over, and at 90
   degrees to the direction of the
   service.
3. Press and release the i Button.
4. The display readout will indicate
   the depth of the service and the
   Line mode icon will be displayed.

☞

- Activating Sonde depth will provide an inaccurate readout.
- Always use chalk or paint to mark services, never pegs or other material which are driven into the ground.
- Additional services may be within the excavation zone, as well as the service you are taking a depth reading from.
- The reading will be more accurate when taken over a straight run, where the service does not bend, or have a service crossing it or coming off it.
- An additional depth reading should be taken with the locator lifted off the ground by approximately 100 mm (4 inches). The reading obtained should confirm the addition of this height.
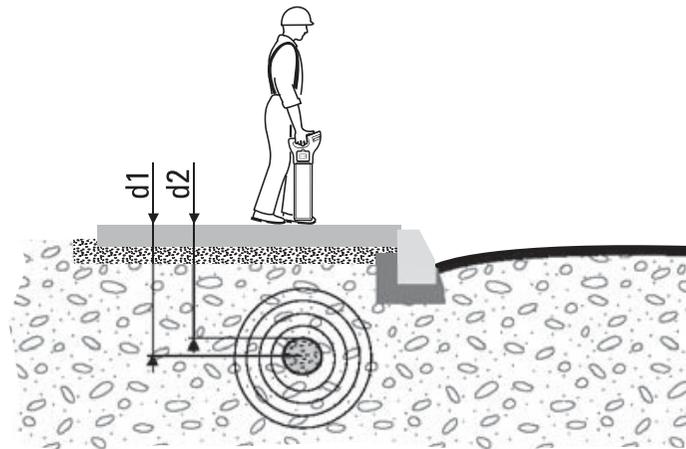
Depth shown and actual depth:

d_1 Depth shown on the Sonel = depth to the centre of the line.

d_2 Actual depth of the service.

Note the difference between d_1 and d_2 !

⚠ **Warning**

The depth reading might not reflect the real depth if your Locator picks up the signal induced into the service by the Transmitter. This signal is radiated from the centre of the service.
This is even more important when the signal is produced by a Sonde, lying in a large diameter conduit!
Precautions:
Always compensate depth reading for service size.

Measuring Sonde depth
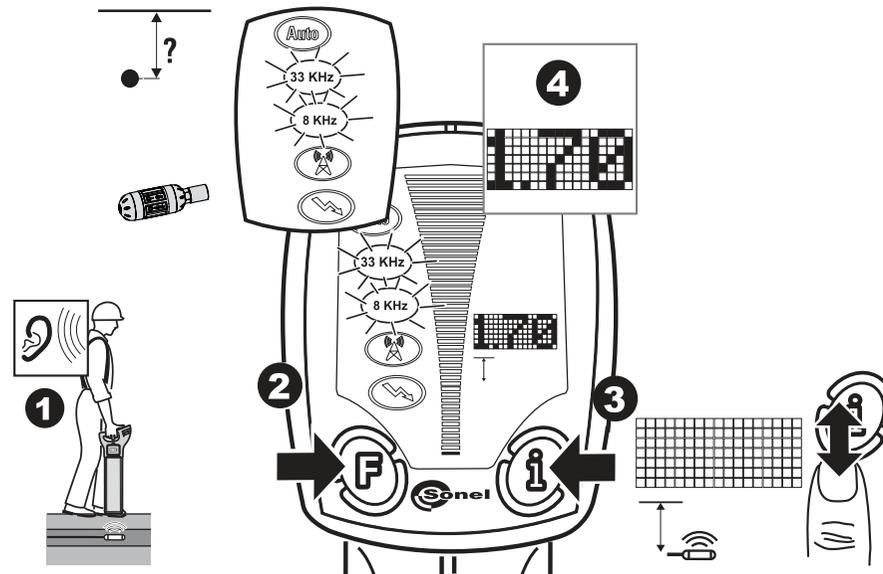
1   Switch on the sonde and set to the required frequency. Refer to Chapter 7 "How to Use the Sonde" for more information.
2. Select either 33kHz or 8kHz mode to suit the Sonde's output.Position the Locator directly over, and in line with the Sonde. Refer to Chapter 7 "How to Use the Sonde" for more information.
3. Press and hold down the iButton for 2 seconds until the dashed lines have scrolled through once.
4. The display readout will indicate the depth of the Sonde and the Sonde mode icon will be displayed.

5. An additional depth reading should be taken with the locator lifted off the ground by approximately 100 mm (4 inches). The reading obtained should confirm the addition of this height.
- Activating line depth will provide an inaccurate readout.
- Always use chalk or paint to mark services, never pegs or other material which are driven into the ground.
- Additional services may be within the excavation zone, as well as the service you are taking a depth reading from.

Depth shown and diameter:
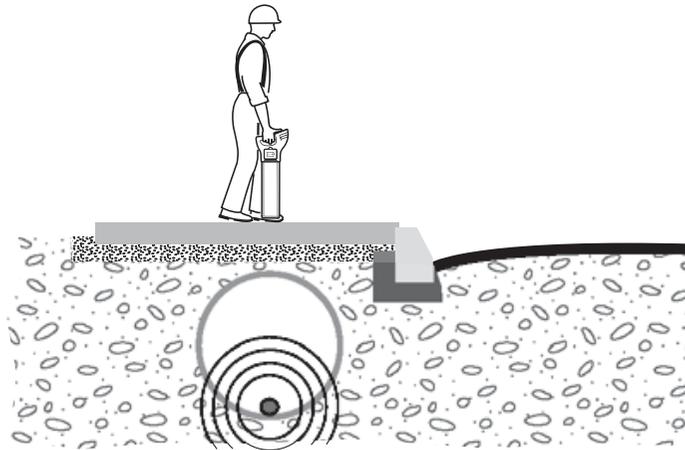
Take special care when the signal is produced by a sonde, lying in a large diameter conduit!

Warning

The depth reading may not indicate the real depth of the service, especially if the sonde is lying at the base of a large diameter duct.

Precautions:

Always compensate depth reading for service size.

Depth code information
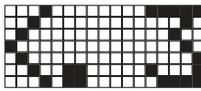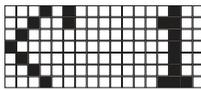
Information code	Description	Information on instrument label
metres ft-inch	The service is too shallow to register properly.	

Information code	Description	Information on instrument label
metres ft-inch	The service is too deep.	
	The signal received by the Locator is too small to register properly.	
	The signal received by the Locator is too large to register properly.	
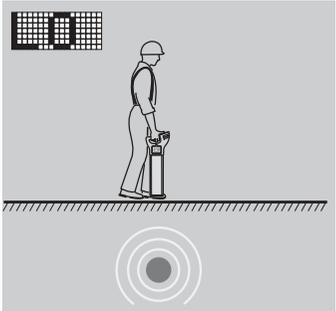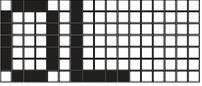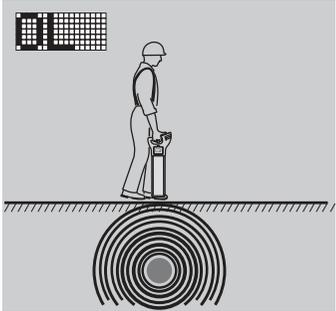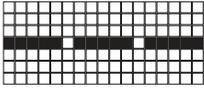
Information code	Description	Information on instrument label
	Depth function not available. The Locator is set to the wrong mode for a depth reading to be taken.	
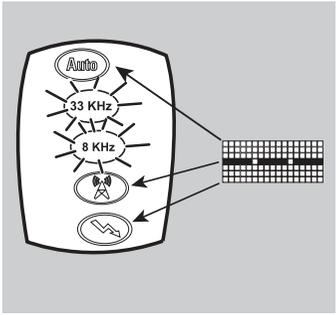
3. How to Use the Transmitter LKN-1000

3.1 General Information

Tracing signal

The Transmitter applies an electrical current signal onto a buried metallic service, which enables the service to be traced and identified by the Locator operating in the same mode.

Operating mode

There are three operating modes for onsite flexibility:
- 8kHz for congested site operation
- 33kHz for general usage
- Combined 8kHz and 33kHz available in Connection mode, enabling rapid selection and convenience on congested sites. The Locator can be used in either mode.

Description

Active tracing is a term frequently used when a Transmitter is used to apply a signal to a service enabling it to be traced. The use of a Transmitter will greatly improve the detection of services especially ones which may not have a signal on them.

The signal from the Transmitter can be applied to services in two ways:
- Induction mode (8kHz or 33kHz):
  Induction is a quick and simple way to apply a signal to a service without the need to make any physical connection to it. The Transmitter uses an internal aerial to transmit the signal, therefore it should be noted that the signal will apply itself to additional services within close proximity to the Transmitter.
- Connection mode (8kHz or 33 kHz or combinded 8kHz and 33kHz):
  This is the most efficient way of applying a signal to a service, and should be used whenever possible. The Transmitter's cable set or any of the available accessories are connected to the service which is to be traced or identified.
- 8kHz is less likely to apply itself to additional services making tracing in areas of multiple services easier.
- 33kHz is suitable for general site use.
- Combined 8 and 33kHz (Connection mode only) is useful in congested areas when either 8 or 33kHz may provide a better result. The best results can be simply achieved by switching modes on the Locator.

3.2   Transmitter Overview

Transmitter LKN-1000 main parts
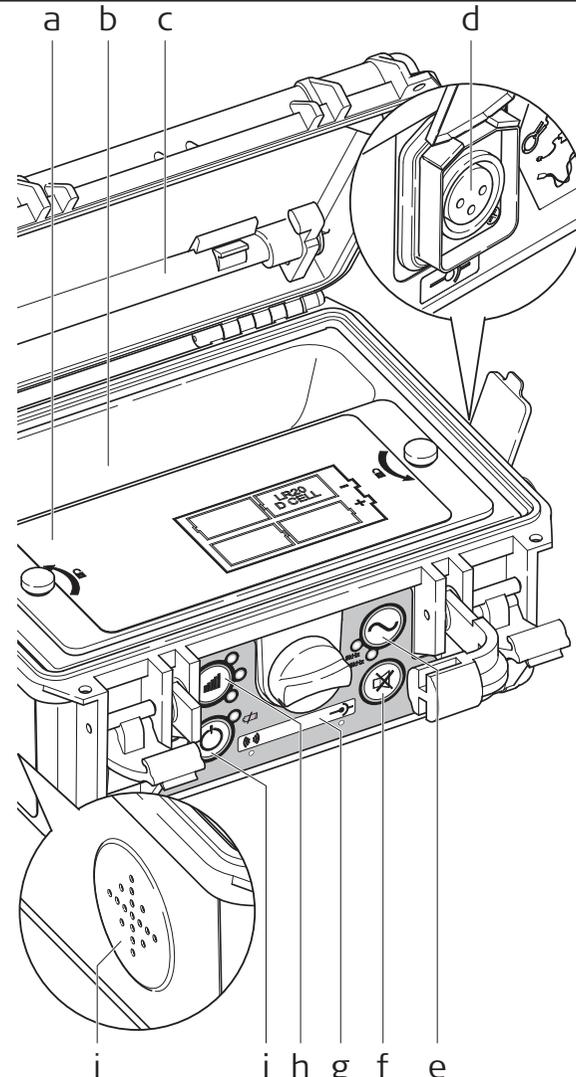
a) Battery Cover
b) Accessory Compartment
c) Earth Pin
d) Connection Socket
    Used to connect accessories directly to metallic services. (Standard: crocodile clip cable set.)
e) Frequency Control and Indicator
    Used to set the Transmitters frequency output. LED illuminates to indicate selection.
f) Mute Control
    Used to silence the Transmitter.
g) Mode Display
    Indicates which mode is selected; Induction or Connection
h) Power Output Control and Indicator
    Press the control to set the Transmitters power output.
    Level 1, minimum power output indicated by the bottom LED illuminated.
    Level 4, maximum power output indicated by all LED's illuminated. Default setting Level two.
i) On - Off control
    Press to switch the transmitter on and off.
j) Speaker

-

Changing the battery

The battery indicator flashes to indicate a poor battery condition.

1. Unscrew the two fasteners and remove the cover.
2. Replace all batteries with four new LR20 (D) type alkaline batteries, or remove and recharge the battery pack if rechargeable batteries are fitted.

Risk of electric shock when removing the Transmitter's battery pack.
Precautions:
Before removing the battery pack switch the transmitter off and remove any cable set or accessories from the connection socket.

4x LR20 (D)
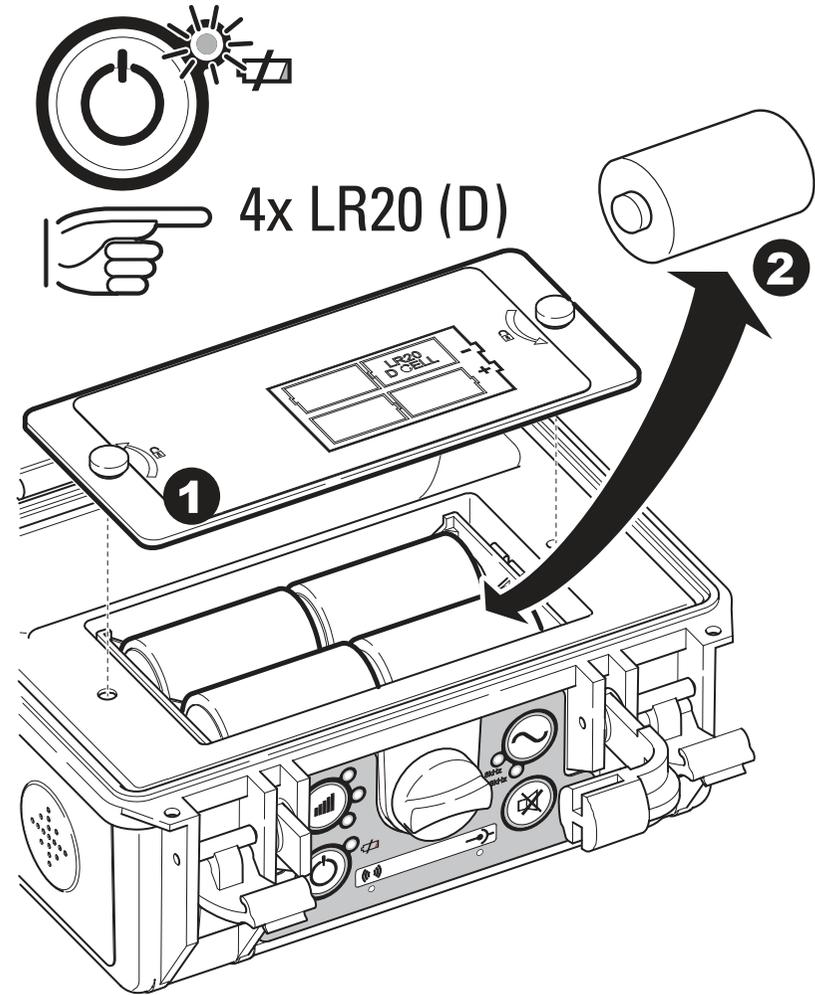
3.3   **How to Locate a Service Using the Transmitter LKN-1000**

Start up test

The following test sequence will take place every time the Transmitter is activated.
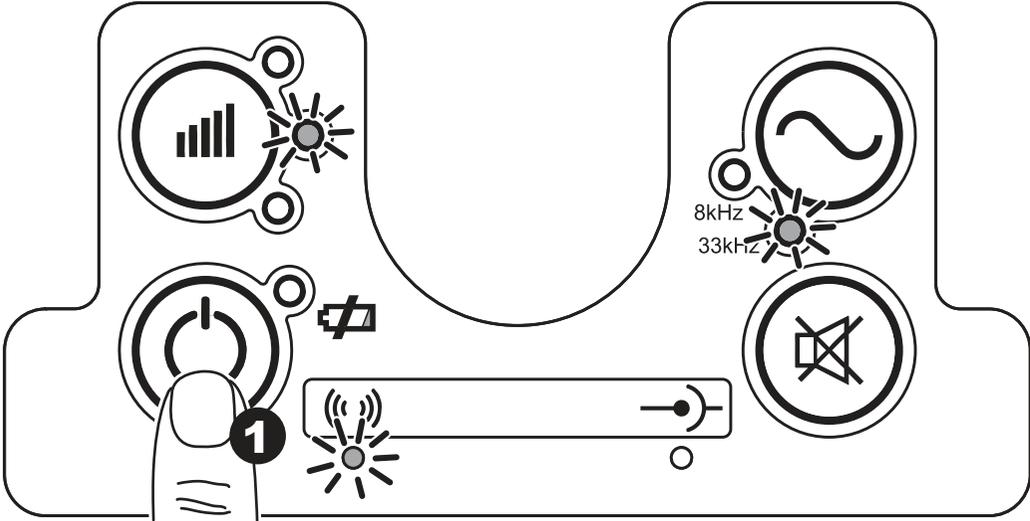
On test	Test pattern
Audio output	On throughout test sequence.
LEDs	LEDs are all lit throughout the test sequence
Default mode selection	33 kHz and power output level two is automatically selected. Induction mode is selected unless the Transmitter's cable set or accessories are connected.

Using the Transmitter in Induction mode
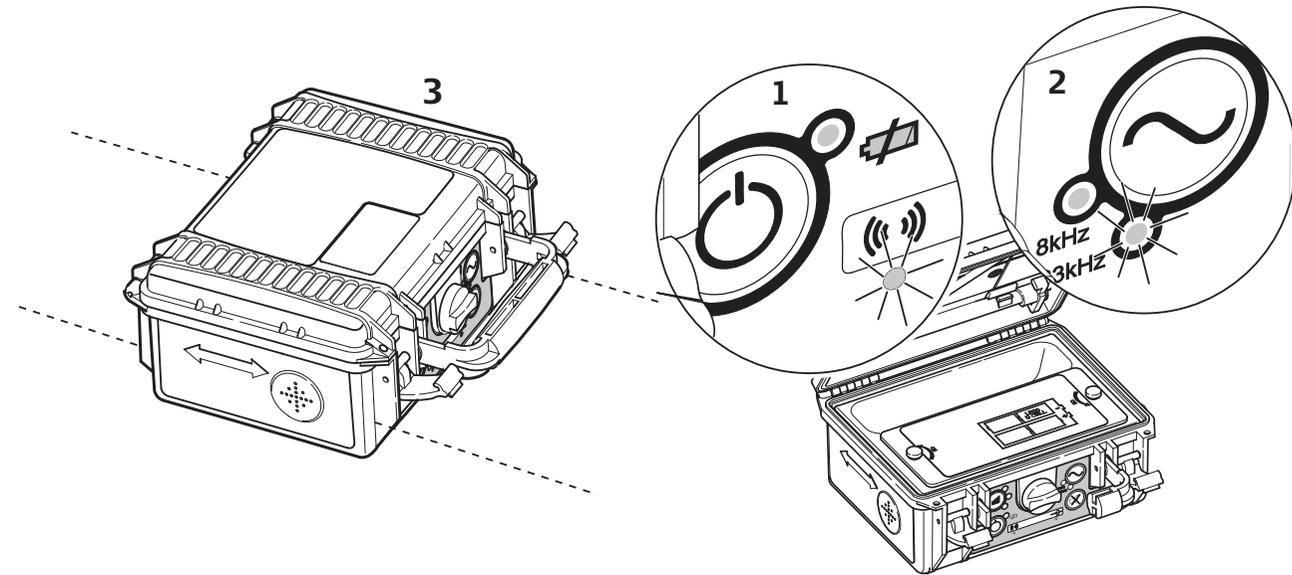
1. Switch the Transmitter on, observe the Induction mode LED is illuminated and the battery level is adequate. Change batteries when indicated.
2. Select the required power output level and frequency output.
3. Place the Transmitter over the service with the arrows running in line with the suspected direction of the service.
4. The tracing signal is induced directly onto the service from the internal aerial.
5. Trace the suspected path of the service using the Locator set to the same frequency. Refer to Chapter 2 "How to Use the Locator" for more information.

- Work at least 10m / 33ft away from the Transmitter to avoid airborne signals. Reposition the Transmitter if required.
- Coupling efficiency is best at 33kHz.
- The signal will couple to adjacent services dependent on depth and direction.
- Reducing the signal output can help to increase the battery life and the Transmitter is less likely to apply a signal to an adjacent service.

Using the Transmitter in Induction mode
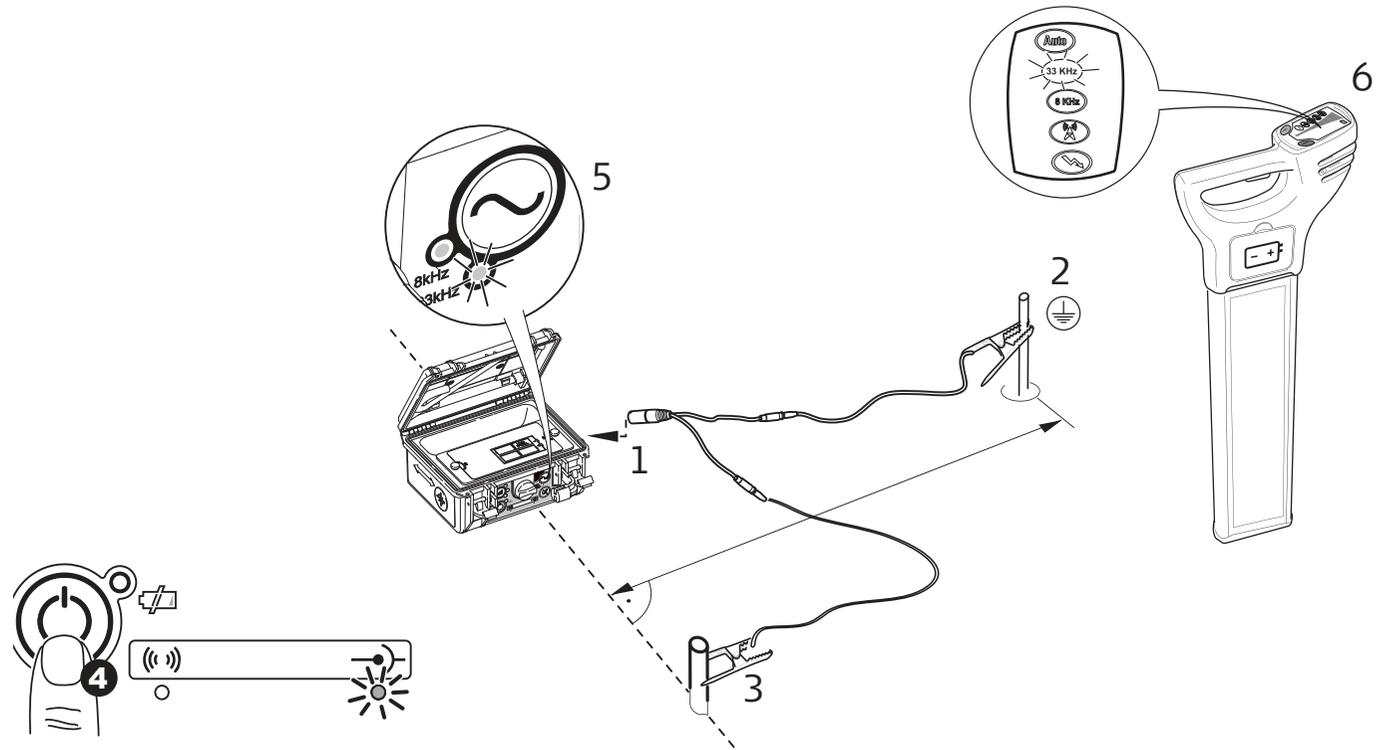
1. Plug the Transmitter's cable set into the connection socket.
2. Connect the black cable to the Earth Pin, ensuring that no services are below push the Earth Pin into the ground.
3. Connect the red cable to the service.
4. Switch the Transmitter on, observe the Connection mode LED is illuminated and the battery level is adequate. Change batteries when indicated.
5. Select the required power output level and frequency output. A good level of tracing signal is indicated when the power output LED & audible tone changes from pulsed to continuous.
6. Trace the signal using the Locator set to the same operating mode. Refer to Chapter 2 "How to use the Locator" for more information.

⚠	**Danger**	Connecting the cable set to a live service can result in an electric shock.
		Precautions:
		The connection cable set should never be connected directly to a live service.
⚠	**Warning**	The transmitter is capable of outputting potentially lethal voltages.
		Precautions:
		Care should be taken when handling exposed or non-insulated connections including;
		the connection cables sets, the Earth Pin and the connection to the service.
		Notify others who may be working on or around the service.
⚠	**Warning**	The transmitter is capable of outputting potentially lethal voltages.
		Precautions:
		Care should be taken when using the maximum power output level.

☞

- Ensure there are no services below the ground when using the earth pin. Use the Locator in advance.
- The black cable can be connected to other metallic structures which go into the ground.
- In dry conditions it may be necessary to add water around the earth point to get a good connection.
- Examine connection points and remove contamination if a continuous audible output is not achieved.
- An extension cable is available to extend the red or black cable sets.

4. How to Use the Conductive Rods: 30meters (WAPRZPN30), 50meters (WAPRZPN50) or 80meters (WAPRZPN80)

4.1 General Information

Description

The Conductive Rod is a service tracer enabling small diameter non-conductive pipes or ducts to be traced. It can be used in Line mode or Sonde mode.

4.1 Conductive Rod Overview
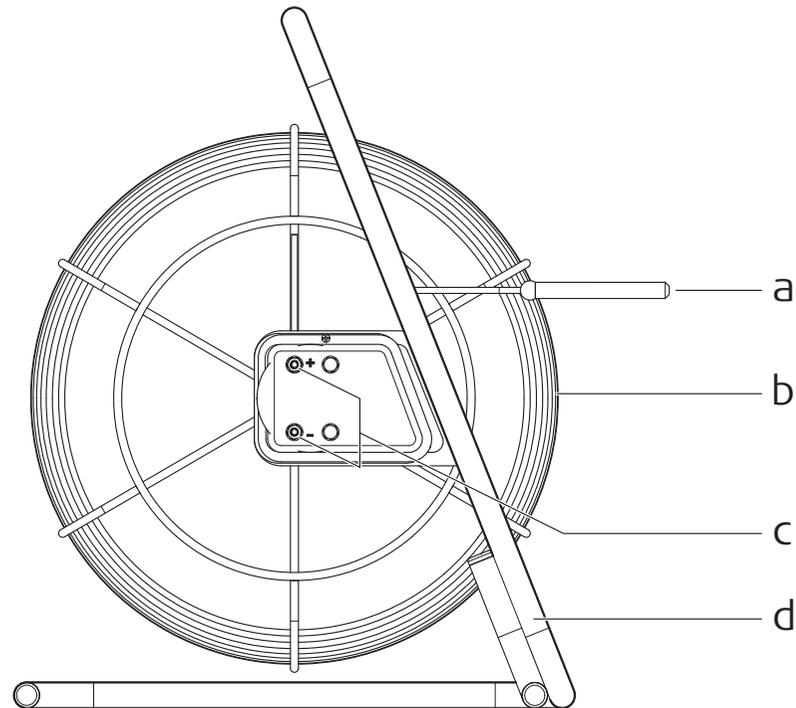
a) End of Coil: Sonde mode
   Used to accurately pinpoint the end point of the rod.
b) Rod: Line mode
   Flexible, Glass Fibre sheathed, which incorporates copper wires to conduct the signal.
c) Signal connection socket
   Used to connect to the Transmitter.
d) Frame
   Houses the flexible rod. Can be used in both vertical (shown) and horizontal orientation.

Using the Conductive Rod in Line mode
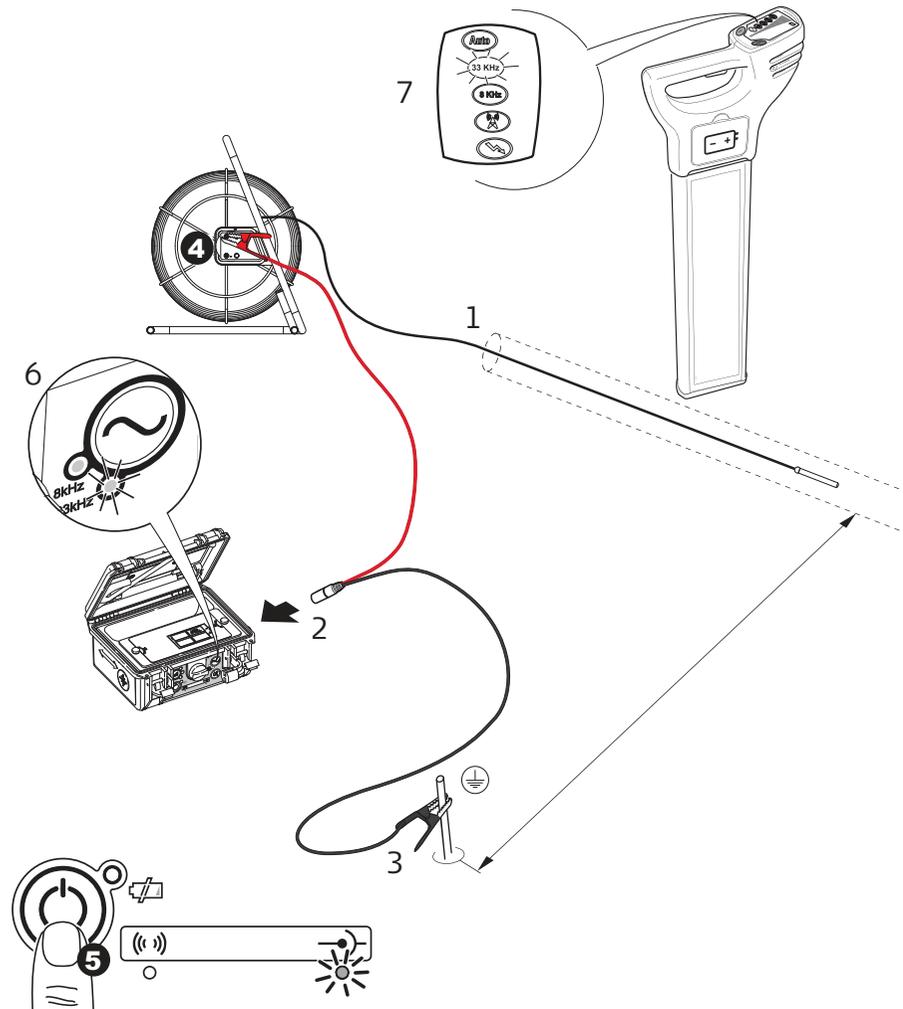
1. Insert the rod into the pipe, duct, conduit or drain until the desired length is in place.
2. Plug the Transmitter's cable set into the connection socket
3. Connect the black cable to the Earth Pin, ensuring that no services are below push the Earth Pin into the ground
4. Connect the red cable to the positive (+) terminal on the conductive rod.
5. Switch the Transmitter on, observe the Connection mode LED is illuminated and the battery level is adequate. Change batteries when indicated.
6. Select the required power output level and frequency output. A good level of tracing signal is indicated when the power output LED & audible tone changes from pulsed to continuous
7. Trace the length of the rod using the Locator set to the same frequency.

☞ • Ensure there are no services below the ground when using the earth pin. Use the Locator in advance.
• At least half the Conductive Rod needs to be uncoiled when in use.

Using the Conductive Rod in Sonde mode

1. Insert the rod into the pipe, duct, conduit or drain until the desired length is in place.
2. Plug the Transmitter's cable set into the connection socket. Connect the red cable to the positive (+) terminal on the conductive rod, connect the black cable to the negative (-) terminal.
3. Switch the Transmitter on and select the required power output level and frequency output. A good level of tracing signal is indicated when the power output LED & audible tone changes from pulsed to continuous. The signal applies itself along the length of the Conductive Rod.
4. Trace the length of the rod using the Locator set to the same frequency.

☞ • At least half the Conductive Rod needs to be uncoiled when in use.

5. How to Use the Signal Clamp N-2

5.1 General Information

Description

The Signal Clamp N-2 provides a safe technique of applying a signal to services such as telecom cables, etc. It is connected to the Transmitter and then clipped around the service. Supply is not interrupted by the applied signal.

5.2 Signal Clamp N-2 Overview

Signal Clamp main parts
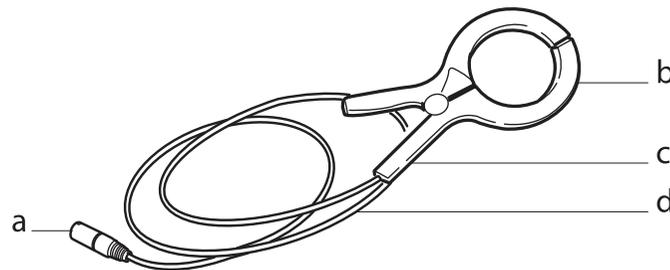
a) Transmitter plug connector
b) Jaws
c) Handle
d) Cable

Using the Signal Clamp
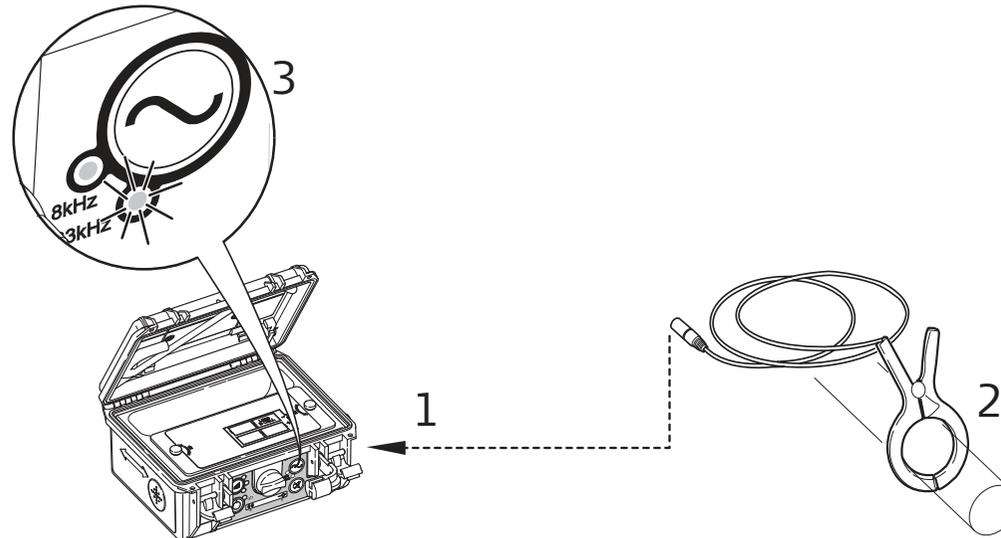
1. Connect the Signal Clamp to the Transmitter.
2. Open the jaws of the Signal Clamp and place around the service to be traced.
3. Switch the Transmitter on and select the required power output level, set the frequency output to correspond with the clamp. A good level of tracing signal is indicated when the audible tone and power output LED are continuous.
4. Trace the length of the service using the Locator set to the same frequency.

- Ensure the clamp jaws are fully engaged.
- Works best in 33kHz mode.

Danger

A hazardous signal may be present on the connection plug of the Signal Clamp when clipped over a live service.
Precautions:
The clamp should be connected to the Transmitter before clamping around a live service.

| ⚠ | **Danger** | A hazardous signal may be present on the service causing personal harm.
Precautions:
Do not use on electrical services which have impaired, or no insulation. If in doubt do not use. |

6. How to Use the Property Connection Set AS-1

6.1 General Information

Description

The Property Connection Set provides a safe technique of applying a traceable signal to live electricity cables. It is connected to the service via a mains plug outlet and provides a traceable signal. Supply is not interrupted by the applied signal and the risk of serious injury is greatly reduced.

6.2 Property Connection Set Overview

Property Connection Set main parts
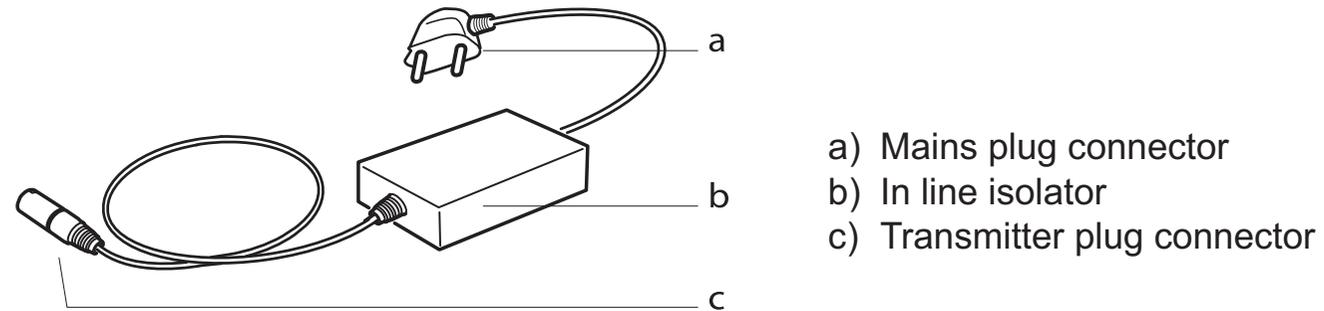
a) Mains plug connector
b) In line isolator
c) Transmitter plug connector

Available different plug connectors:

Europe („French") standard	**WAADAAS1PL**
Switzerland standard	**WAADAAS1CH**
Australian standard	**WAADAAS1AU**
US standard	**WAADAAS1US**
UK standard	**WAADAAS1UK**

Using the Property Connection Set
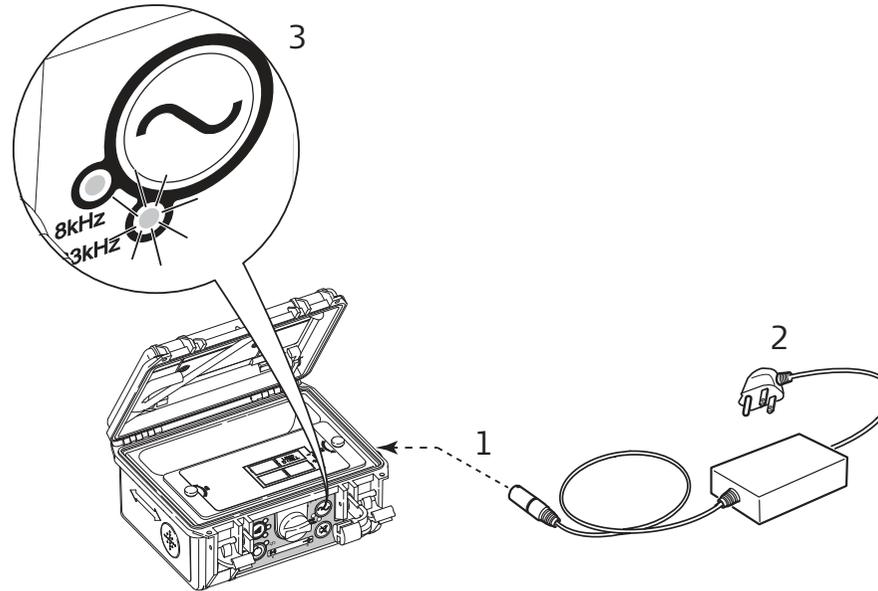
1. Connect the Property Connection Set to the Transmitter.
2. Connect the Property Connection Set to a live mains outlet. Ensure the switch on the mains is on.
3. Switch the Transmitter on and select the required power output level, set the frequency output to correspond with the Property Connection Set. A good level of tracing signal is indicated when the audible tone and power output LED are continuous.
4. Trace the length of the service using the Locator set to the same frequency.

• The mains supply must be live and switched on for correct operation.
• Ensure the Transmitter's frequency output is comparable to that of the Property Connection Set.
• Check the Property Connection Set type plate for the frequency rating.
• Works best with 33kHz.

⚠ Danger   A hazardous signal may be present on the connection plug of the Property Connection Set when connected to the mains supply.
Precautions:
The Property Connection Set should be connected to the Transmitter before connecting to the mains supply.

⚠ Danger   A hazardous signal may be present on the service or mains outlet causing personal harm.
Precautions:
Do not use on electrical services which have impaired, or no insulation. If in doubt do not use.

7. How to Use the Sonde NAD-1

7.1 General Information

Description

The Sonde is a dual frequency signal transmitter used to trace drains, sewers and other non conductive services. It can be attached to a range of equipment including drain rods, boring tools and inspection cameras. It is powered by a 1.5V LR6 (AA) battery, so unlike other accessories this does not require a connection to the transmitter. The signal pattern transmitted from the Sonde is different to that which is radiated from a service; transmitting a peak signal over its main body, with a ghost signal at the front and back. This requires the Sonde to be traced with its own unique method. The i-Series Locators feature a numeric signal strength indicator (user setting SSI set to ON) which will greatly improve the locating process.

☞ The numeric signal strength indicator is shown in the display readout on the Locator.

7.2 Sonde Overview

Sonde main parts
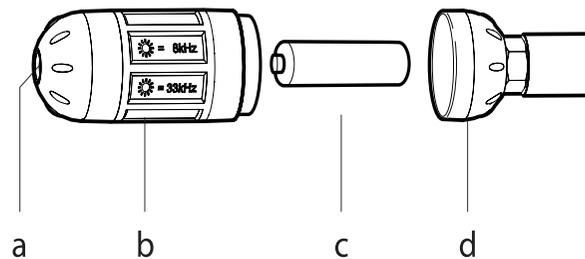
a) LED
b) Sonde body
c) LR6 (AA) battery
d) End cap and M10 connection point

☞ The thread on the Sonde is a male M10, and comes with adaptors to both British and European drain rods.

Changing the frequency output

Changing to 33kHz mode:
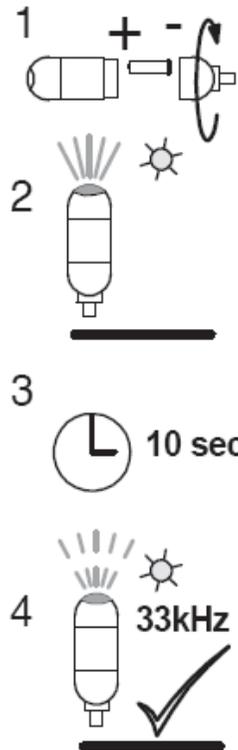
1. Unscrew and remove end cap. Insert battery, positive end first. Refit end cap securely.
2. Hold Sonde upright.Confirm green LED is continuous.
3. Wait approximately 10 seconds for the green LED to start flashing.
4. With the green LED flashing, the Sonde is ready for use at 33kHz.

Changing to 8kHz mode:
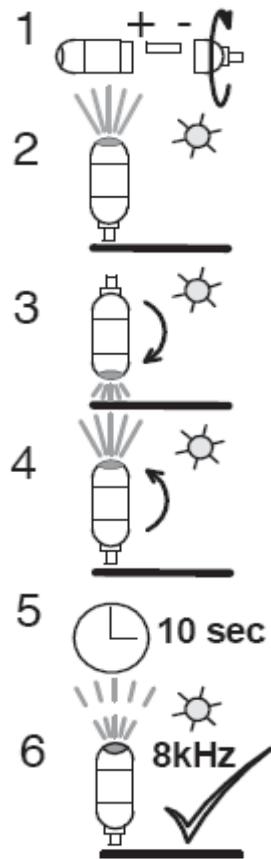
1. Unscrew and remove end cap.
   Insert battery, positive end first.
   Refit end cap securely.
2. Hold Sonde upright.
   Confirm green light is continuous.
3. Rotate Sonde so the LED points down and wait approximately 1second.
4. Rotate Sonde upright.Confirm the amber coloured LED is continuous.If LED remains green repeat from step 1.
5. Wait approximately 10 seconds for the amber LED to start flashing.
6. With the amber LED flashing, the Sonde is ready for use at 8kHz.

Once the function of the Sonde has been checked with a Locator set to the same operating mode it can be attached to drain rods or other means of guiding it into the service being traced.
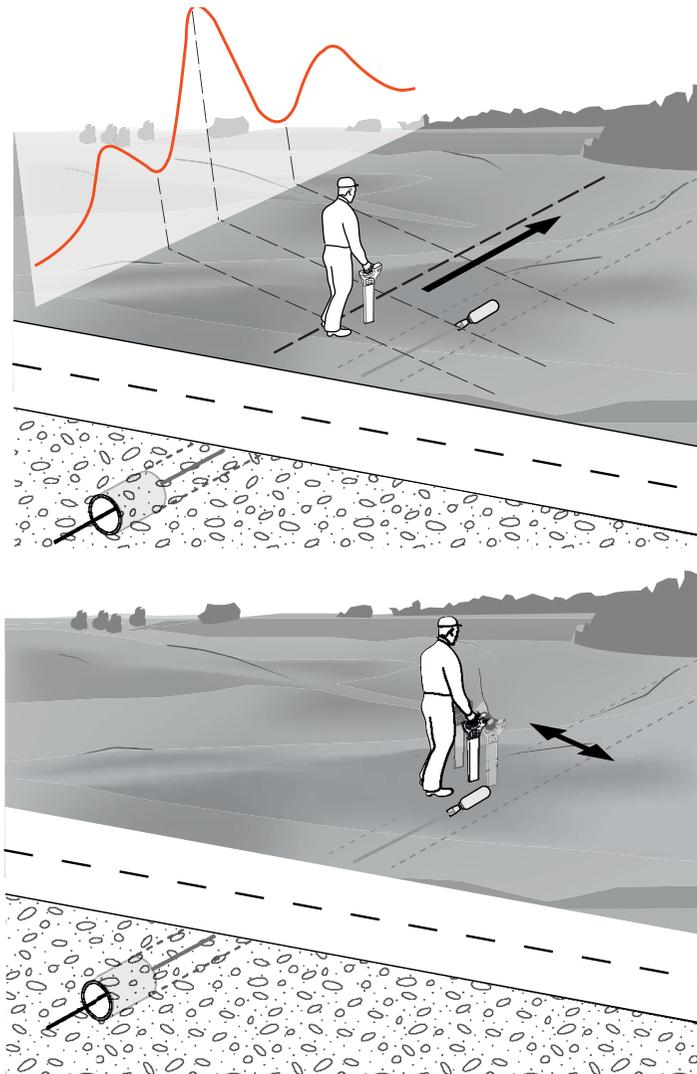
Locating the Sonde

1. Walk in line with the suspected direction of travel observing the display. The signal strength indicator will rise and fall as you pass over the ghost signal at the back of the Sonde, the peak signal directly over the Sonde and the ghost signal at the front. The numeric signal strength indicator will display its highest value when detecting the peak signal.

2. Retrace your steps and position the locator directly over the peak signal. Move the locator left and right until the highest numeric reading is obtained. This reading will indicate the Sonde's precise location.

3. Depth indication
Depth indication can be used with a suitable depth locator. The locator must be positioned directly over the Sonde and in line with it (rotate the locator on its axis to find the highest reading). Press and hold the i Button for 2 seconds. The depth of the Sonde will be displayed in the depth readout window and the Sonde mode icon will be visible beneath the display.

- For ease and convenience mark the ground every 3 to 4 metres.
- For ease of use practice the process above ground

Tracing a "walk through" sewer
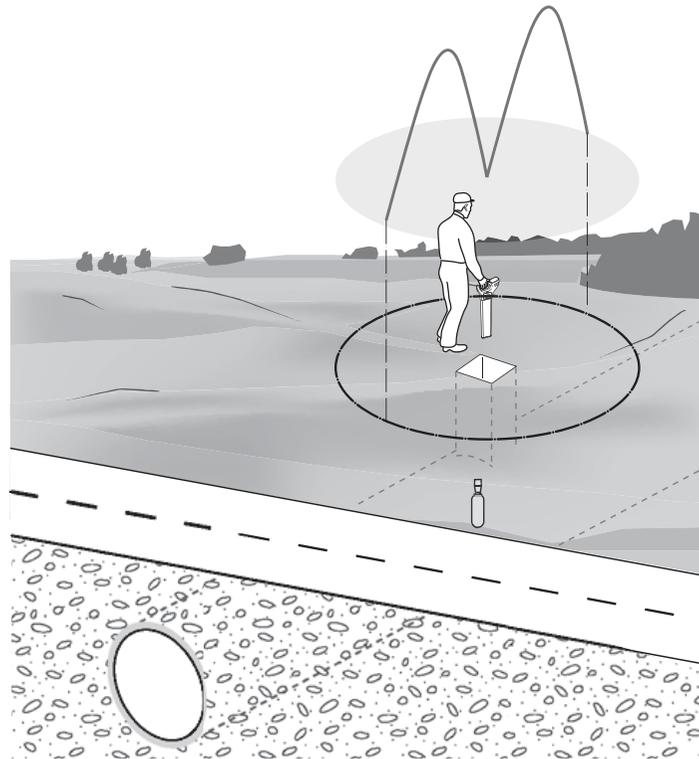
If a "walk through" sewer is being traced, another method is to place the Sonde vertically, for example to pinpoint a buried manhole. The Locator will pick up a pool of signal with a null point at the centre. This is an accurate method, but it is essential to ensure the Sonde is vertical.

8. Care and Transport

8.1 Transport

Transport in the field

When transporting the equipment in the field, always make sure that you carry the product in its original transport container.

Transport in a road vehicle

Never carry the product loose in a road vehicle, as it can be affected by shock and vibration. Always carry the product in its transport container and secure it.

Shipping

When transporting the product by rail, air or sea, always use the complete original Sonel packaging, transport container and cardboard box, or its equivalent, to protect against shock and vibration.

Shipping, transport of batteries

When transporting or shipping batteries, the person in charge of the product must ensure that the applicable national and international rules and regulations are observed. Before transportation or shipping, contact your local passenger or freight transport company.

8.2 Storage

Product

Respect the temperature limits when storing the equipment, particularly in summer if the equipment is inside a vehicle. Refer to Chapter 10 "Technical Data" for information about temperature limits.

If the equipment is to be stored for a long time, remove the alkaline batteries from the product in order to avoid the danger of leakage.

8.3 Cleaning and Drying

Dry the product, the transport container, the foam inserts and the accessories at a temperature not greater than 40°C / 104°F and clean them. Do not repack until everything is completely dry.

Keep plugs clean and dry. Blow away any dirt lodged in the plugs of the connecting cables.

9. Technical Data

9.1 Locator LKO-1000 Technical Data

Typical detection range

Mode	Distance along conductor
Power Mode	length of conductor
Radio Mode	length of conductor
Conductive Rod Mode	length of unwound rod

Operating depth range

Mode	Range
Power Mode	to 3m / 10ft
Radio Mode	to 2m / 7ft
Transmitter Mode	to 3m / 10ft

Typical depth accuracy

10% of depth in line or Sonde
0.3 to 3.0m (1 to 10 ft) depth range

Operating frequencies

Mode	Frequency
Power Mode	50Hz or 60Hz
Radio Mode	15kHz to 60kHz
8kHz Mode	8.192 (8) kHz

Operating frequencies

Mode	Frequency
33kHz mode	32.768(33)kHz
Auto mode	Power mode and Radio mode

Additional Extras

Feature	Specification
Bluetooth (when fitted)	Class 2, Nom 30metres
Memory Capacity	32Mb

Display Panel

- 48 segment bar graph
- 5 mode indicators
- Battery status indicator
- Line depth indicator
- Sonde depth indicator
- Bluetooth indicator
- Integrated backlight
- Annual service indicator
- 3 alpha numeric dot matrix displays 5x7

Keypad

2 membrane push buttons

Speakers

- Dual speakers:
Audio volumes: 85 dBA @ 30 cm
Tone: Power, Radio and Auto mode: continuous tone (different pitch for each tone),
         8kHz and 33kHz mode: pulsed tone (different pitch for each tone). All five tones are
         different.
- Pneumatic headphone sockets are integrated

Internal battery

Type: 6 x LR6 (AA) alkaline

Typical operating time: 40hrs intermittent use at 20°C / 68°F; in 8kHz mode or 33kHz mode

Instrument dimensions

85 mm/3.4 Inches

760 mm/30 Inches

250 mm/10 Inches
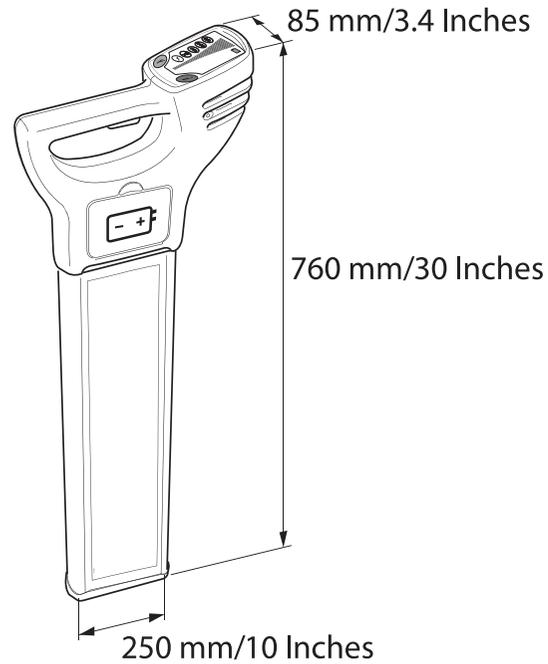
Weight

Instrument: 2.7kg / 6lbs
(including batteries)

Environmental specifications

Type		Description
Temperature	Operating	-20°C to +50°C -4°F to +122°F
	Storage	-40°C to +70°C -40°F to +158°F
Protection	against Water, Dust and Sand	IP54 (IEC 60529) Dust-protected
Humidity		95% RH non condensing The effects of condensation are to be effectively counteracted by periodically drying out the product.

Conformity to national regulations

- FCC Part 15 (applicable in US)
- Hereby, Sonel S.A. declares that the Locator LKO-1000 is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC. Class 1 equipment according European Directive 1999/5/EC (R&TTE) can be placed on the market and be put into service without restrictions in any EEA member state.
- The conformity for countries with other national regulations not covered by the FCC part 15 or European directive 1999/5/EC has to be approved prior to use and operation.

Frequency band

50Hz to 60kHz

Output power

Receive only

9.2   Transmitter Technical Data LKN-1000

Typical detection range

Mode	Distance
Induction mode	150m / 490ft
Connection mode	250m / 820ft

Operating transmission frequencies

- 8.192(8)kHz
- 32.768(33)kHz

Display panel

- 2 LED Mode Indicators
- 2 LED Frequency Indicators
- LED Battery Status Indicator
- 3 LED Power Output Indicators

Keypad

4 membrane push buttons

Integral Speakers

Audio volumes:	85 dBA @ 30 cm
Tone:	8kHz mode: Low pitched tone
	33kHz mode: Higher pitched tone
	Induction mode: Pulsed tone
	Connection mode: Pulsed tone when poor or no current output, continuous tone when good connection

Internal battery

Type:	4 x LR20(D) alkaline, supplied; or recharcheable battery D type
Typical operating time:	30hrs intermittent use at 20°C / 68°F

Instrument dimensions

180 mm/7 Inches

260 mm/10.2 Inches

280 mm/11 Inches
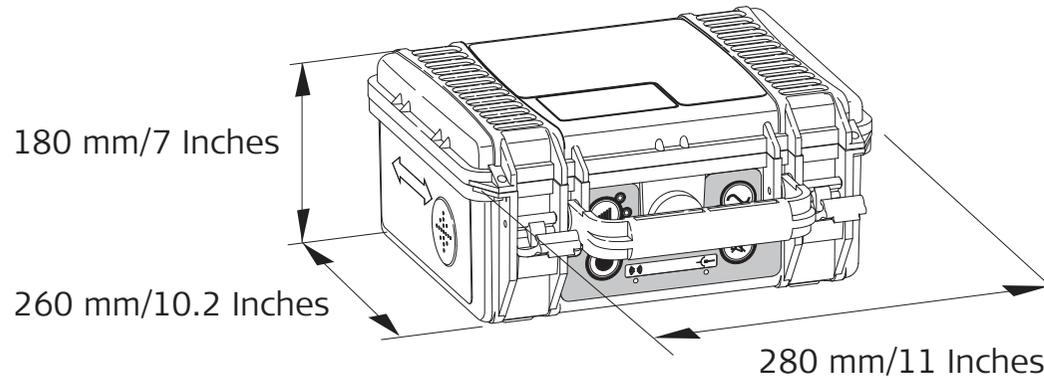
Weight

| Instrument: | 2.4kg / 5.3lbs |
| (including batteries) | |

Environmental specifications

Type		Description
Temperature	Operating	-20°C to +50°C -4°F to +122°F
	Storage	-40°C to +70°C -40°F to +158°F
Protection against Water, Dust and Sand	With cover open	IP54 (IEC 60529) Dust-protected
	With cover closed and secured	IP65 (IEC 60529) Dust tight Waterproof to 1m temporary immersion
Humidity		95% RH non condensing. The effects of condensation are to be effectively counteracted by periodically drying out the product.

Conformity to national regulations	• FCC Part 15 (applicable in US) • Hereby, Sonel S.A. declares that the transmitter LKN-1000 is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC. Class 1 equipment according European Directive 1999/5/EC (R&TTE) can be placed on the market and be put into service without restrictions in any EEA member state. • The conformity for countries with other national regulations not covered by the FCC part 15 or European directive 1999/5/EC has to be approved prior to use and operation.
Output power	1W maximum, when directly connected to a buried service with a ground impedance of 100 Ohm or less.

9.3   Conductive Rods Technical Data

Typical detection range	Both modes, Line and Sonde: Typical 3.0m / 10ft
Tracing distance	max: 30m/99ft (WAPRZPN30); 50m/165ft (WAPRZPN50); 80m/263ft (WAPRZPN80). Reel length dependant
Operating transmission frequencies	• 8.192(8)kHz or • 32.768(33)kHz

Instrument dimensions

Ø 13 mm/0.512 Inches

490 mm/19.3 Inches

210 mm/8.3 Inches

440 mm/17.3 Inches
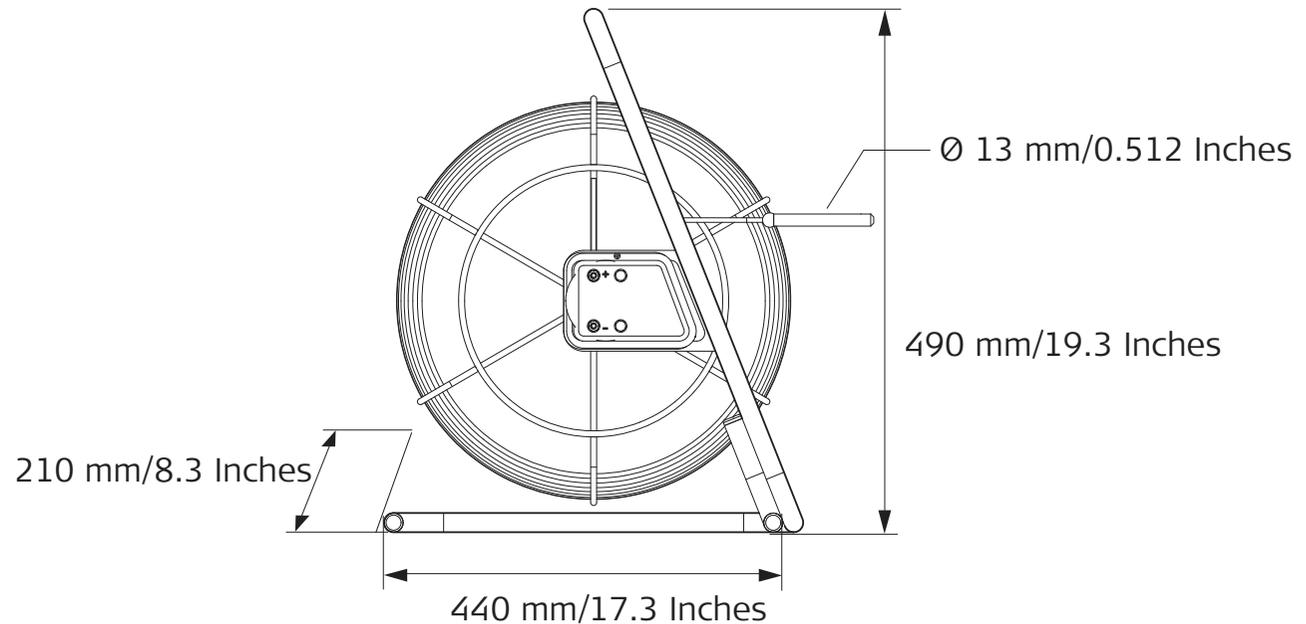
Weight	Instrument: 7.3kg / 16.1lbs

Environmental specifications

Type		Description
Temperature	Operating	-20°C to +50°C -4°F to +122°F
	Storage	-40°C to +70°C -40°F to +158°F
Protection against Water, Dust and Sand	Frame	IP54 (IEC 60529)Dust-protected
	Rod	Fully submersible
Humidity		95% RH non condensingThe effects of condensation are to be effectively counteracted by periodically drying out the product.

Conformity to national regulations

- FCC Part 15 (applicable in US)
- Hereby, Sonel S.A. declares that the Conductive Rod is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC.

  $\mathcal{C}\mathcal{E}$ Class 1 equipment according European Directive 1999/5/EC (R&TTE) can be placed on the market and be put into service without restrictions in any EEA member state.
- The conformity for countries with other national regulations not covered by the FCC part 15 or European directive 1999/5/EC has to be approved prior to use and operation.

9.4   Sonde NAD-1 Technical Data

Operating transmission frequencies

- 8.192(8)kHz
- 32.768(33)kHz

Type:	1 x LR6 (AA) alkaline
Typical operating time:	40 hrs intermittent use at 20°C / 68°F; in 8 kHz mode or 33 kHz mode

Instrument dimensions

Ø38 mm/1.5 Inches

120 mm/4.7 Inches

Weight

Instrument: (including batteries)	0.18 kg / 0.4 lbs

Environmental specifications

Type		Description
Temperature	Operating	-20°C to +50°C -4°F to +122°F
	Storage	-40°C to +70°C -40°F to +158°F
Protection	against Water, Dust and Sand	Fully submersible
Humidity		95% RH non condensing The effects of condensation are to be effectively counteracted by periodically drying out the product.

Conformity to national regulations

- FCC Part 15 (applicable in US)
- Hereby, Sonel S.A. declares that the Sonde is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC.
  Class 1 equipment according European Directive 1999/5/EC (R&TTE) can be placed on the market and be put into service without restrictions in any EEA member state.
- The conformity for countries with other national regulations not covered by the FCC part 15 or European directive 1999/5/EC has to be approved prior to use and operation.

9.5   Property Connection Set AS-1 Technical Data

Operating transmission frequencies
- 8.192(8)kHz
- 32.768(33)kHz

Instrument dimensions

80 mm/3.1 Inches

100 mm/3.9 Inches
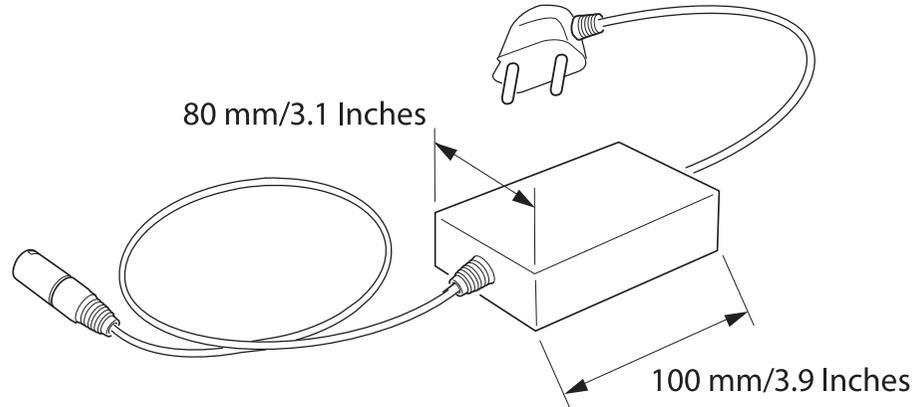
Weight

Instrument: 0.15 kg / 0.3 lbs

Type		Description
Temperature	Operating Storage	-20°C to +50°C -4°F to +122°F -40°C to +70°C -40°F to +158°F
Protection	against Water, Dust and Sand	IP54 (IEC 60529)Dust-protected
Humidity		95% RH non condensing The effects of condensation are to be effectively counteracted by periodically drying out the product.

Conformity to national regulations

- FCC Part 15 (applicable in US)
- Hereby, Sonel S.A. declares that the Property Copnnection Set is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC. Class 1 equipment according European Directive 1999/5/EC (R&TTE) can be placed on the market and be put into service without restrictions in any EEA member state.
- The conformity for countries with other national regulations not covered by the FCC part 15 or European directive 1999/5/EC has to be approved prior to use and operation.

Available different plug connectors:

Europe („French") standard   **WAADAAS1PL**
Switzerland standard   **WAADAAS1CH**
Australian standard   **WAADAAS1AU**
US standard   **WAADAAS1US**
UK standard   **WAADAAS1UK**

9.6   Signal Clamp N-2 Technical Data

Operating transmission frequencies

32.768(33)kHz (recommended)
when used with a signal transmitter set in 33kHz mode.

Instrument dimensions

250 mm/9.8 Inches

142 mm/5.6 Inches

100 mm/4 Inches
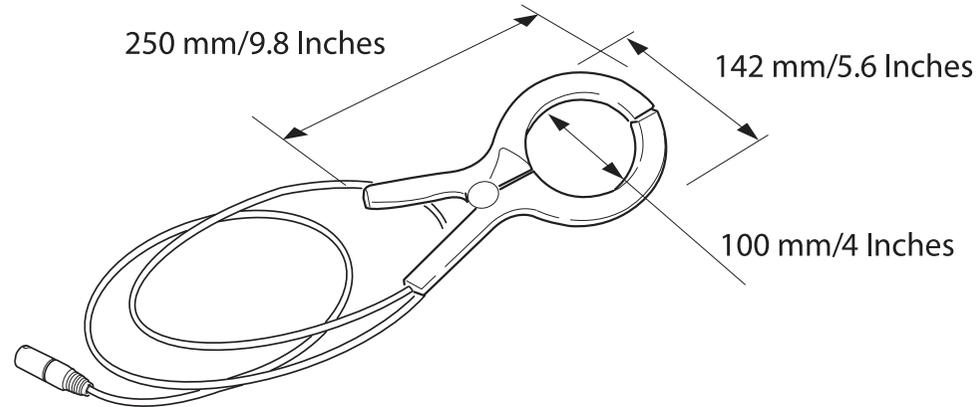
Weight

Instrument: 0.354kg / 0.76lbs

Type		Description
Temperature	Operating	-20°C to +50°C -4°F to +122°F
	Storage	-40°C to +70°C -40°F to +158°F
Protection	against Water, Dust and Sand	IP54 (IEC 60529)Dust-protected
Humidity		95% RH non condensing The effects of condensation are to be effectively counteracted by periodically drying out the product.

Conformity to national regulations

- FCC Part 15 (applicable in US)
- Hereby, Sonel S.A. declares that the Signal Clamp N-2 is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC.
  Class 1 equipment according European Directive 1999/5/EC (R&TTE) can be placed on the market and be put into service without restrictions in any EEA member state.
- The conformity for countries with other national regulations not covered by the FCC part 15 or European directive 1999/5/EC has to be approved prior to use and operation.

Appendix A

A.1

Checking the Function

Functional Checks

Locator Functional Check

Before any tests can be carried out it is vital to check the status of the unit, its batteries and basic functionality.
The following list is used to achieve this.

1. Inspection
• Casing   The casing should be free of significant damage.
• Labels   Body labels must be legible and intact. Display label must be free of damage and tears.
• Battery hatch   The hatch must lock into place.
• Battery holder   All the battery contacts and springs on the holder must be free of corrosion and the holder in good condition.
• Battery contacts   The battery contacts must be free of corrosion.

Once the general condition of the Locator is established the Audio Visual test can be performed.

2. Audio / Visual display test
Upon depressing the trigger the Locator should test the display and speakers by illuminating each segment in the bar display, the mode and function indicators and depth display, the battery indicator light will illuminate throughout the display test. All LCDs must be operative and an audible output must be heard.

3. Battery / Functional self check

If there is no response when the trigger is activated or the low battery illuminates (or flashes) after the Audio / Visual display test, the batteries will have to be replaced. Use alkaline batteries. Replace all of the batteries at the same time.

Checking the Performance

The purpose of the following procedure is to verify the performance of the Locator. It is important that the test is conducted away from areas of electromagnetic interference or over buried services with a large signal radiating off them.

1. Switch the Locator on.
2. Whilst in Power mode hold down the i Button, until the settings are displayed.
3. Using the Function Button toggle through the settings until EST is displayed.
4. Press the i Button to activate the test.
5. Observe the displayed output:
    PAS means unit is within set tolerances.
    ERR means unit is outside set tolerances and may need servicing

• Repeat the test in a different location if the units displays ERR.
• The Locator will automatically repeat the function test if it fails.
• Repeated failure will indicate a faulty unit, which must be returned for service.

Checking depth indication

This test can be carried out provided the depth of a service on the test area is known.

1. Switch the Locator on and ensure that it is in 33kHz mode.
2. Position the Locator directly over and at right angle to the service.
3. Press and release the i Button to activate the depth measurement.
4. Record the depth.
5. If the depth reading deviates from the normal value or an error code is displayed, the Locator should be returned for service.

☞ **If any of these tests give no response or a significantly different response from normal, the Locator should be returned for service.**

Functional test check list

Functional test check list					
Unit: Locator...		Serial Number:		Comments:	
Test	Operative			Fail analysis	Notes
	Yes	No	N/A		
1. Casing				Return for repair/ Replace	Casing should be free of damage.
2. Labels				Return for repair/ Replace	Body labels must be legible and intact. Display label must be free of damage and tears.
3. Battery hatch				Return for repair/ Replace	Hatches must be free of corrosion.
4. Battery holder				Replace	Holder must be free of corrosion.
5. Battery contacts				Return for repair	Contacts must be free of corrosion.
6. Audio/Visual display test				Return for repair	LCD is illuminated and an audible output must be heard.

Functional test check list					
7. Batteries				Replace	Replace alkaline batteries if pack is exhausted (no response) or if the battery indicator light is illuminated or flashing after display test. Replace all batteries!
8. Power mode				Return for repair	Response width and peak value similar to test unit.
9. Radio mode				Return for repair	Response width and peak value similar to test unit.
10. 8 kHz				Return for repair	Response width and peak value similar to test unit.
11. 33 kHz				Return for repair	Response width and peak value similar to test unit.
12. Depth Mode 8kHz and 33kHz				Return for repair	Gives same result as test unit (10% accuracy).
Tested by:					Date:

A.2   Transmitter Functional Check

Checking the Function

The purpose of the following procedure is to verify the performance of the Signal Transmitter.

Before any tests can be carried out it is vital to check the status of the unit, its batteries and basic functionality.

To carry out this test the following are required:
• A Locator to detect the signals.
• A test area free of services as illustrated.

1. Inspection
• Casing	The casing should be free of significant damage.
• Labels	Body labels must be legible and intact. Display label must be free of damage and tears.
• Battery hatch	The hatch must lock into place.
• Battery holder	All the battery contacts and springs on the holder must be free of corrosion and the holder in good condition.
• Battery contacts	The battery contacts must be free of corrosion.

Once the general condition of the Transmitter is established the Audio Visual test can be performed.

2. Audio / Visual display test
Turn on the Transmitter. The LED display will illuminate and the speakers will emit a tone, the battery/output level indicator will illuminate throughout the test. All LEDs must be operative and an audible output must be heard.

3. Battery check

The battery indicator flashes to indicate a poor battery condition. Replace all batteries with four new LR20 (D) type alkaline batteries, or remove and recharge the battery pack if rechargeable batteries are fitted.

Checking the performance

The purpose of the following procedure is to verify the performance of the Transmitter. It is important that the test is conducted away from areas of electromagnetic interference.

1. Plug the Transmitter's cable set into the connection socket.
2. Connect the black and red cable clips together, ensuring good metal to metal contact.
3. Hold down Frequency Control Button and switch the Transmitter on. Note, Hold the frequency control button down until the Extended Self Test has commenced.
4. Observe the displayed output:

Induction Mode Test Mode Display: Induction LED illuminated.

Frequency Display: Frequency LED illuminates showing the frequency on test.

Mode Display: Induction LED off.

Connection Mode Test Mode Display: Connection LED illuminated.

Frequency Display: Frequency LED's illuminates showing the frequency on test.

Mode Display: Connection LED off.

5. The transmitter will display the outcome:

Pass Battery indicator: LED Flash (if tested with poor batteries).

Audible Output: High - Low pulsed tone emitted three times.

Fail Battery indicator: LED Flash (if tested with poor batteries).

Audible Output: Low pitch tone emitted.

Mode Display: Induction or Connection LED illuminated to show failure mode.

Frequency Display: Frequency LED illuminated to show frequency failure.

☞ **• If the unit fails check the Transmitter's cable set is fully engaged and the clips are connected.**
• Repeated failure will indicate a faulty unit, which must be returned for service.

☞ **If any of these tests give no response or a significantly different response from normal, the Transmitter should be returned for service.**

⚠ **Warning**
The transmitter is capable of outputting potentially lethal voltages.
Precautions:
Care should be taken when handling exposed or non-insulated connections including;
the connection cables sets, the Earth Pin and the connection to the service.
Notify others who may be working on or around the service.

Functional test check list

Functional test check list					
Unit: Transmitter...		Serial Number:		Comments:	
Test	Operative			Fail analysis	Notes
	Yes	No	N/A		
1. Casing				Return for repair/ Replace	Casing should be free of damage.
2. Labels				Return for repair/ Replace	Body labels must be legible and intact. Display label must be free of damage and tears.
3. Battery cover and accessory cover				Return for repair/ Replace	Hatches must lock into place.
4. Battery contacts				Replace	Contacts must be free of corrosion.
5. Audio/Visual display test				Return for repair	All LEDs must illuminate and an audible output must be heard.
6. Batteries				Return for repair	Replace alkaline batteries if exhausted (no response) or if the battery indicator light is illuminated or flashing after display test. Replace all batteries!

Functional test check list					
7. Induction mode				Return for repair / Replace	Reduced or no output signal.
8. Connection mode; no change in audio indication				Return for repair / Replace	Faulty cable.
9. Connection mode; no change in audio indication				Return for repair / Replace	No output signal.
Tested by:					Date:

A.3   Conductive Rod Functional Check

Checking the Function

The purpose of the following procedure is to verify the performance of the Conductive Rod.

To carry out this test the following are required:
- A Transmitter for generating the signal in the Sonde and Line mode tests
- The cable set for the Conductive Rod.

Plug the Transmitter's cable set into the connection socket. Connect the red cable to the positive (+) terminal on the conductive rod, connect the black cable to the negative (-) terminal.

Switch the Transmitter on and adjust the power output on the Transmitter to minimum, the audible output must be constant. Disconnect the black cable from the negative (-) terminal, the audible output must be pulsed.

If any of these tests give no response or a significantly different response from normal, the Conductive Rod should be returned for service.

Functional test check list

Functional test check list					
Unit: Conductive Rod...	Serial Number:		Comments:		
Test	Operative			Fail analysis	Notes
	Yes	No	N/A		
1. Sonde mode: Transmitter audio output does not go continuous				Return or replace cable set	Faulty cable.
2. Sonde mode: Locator does not detect signal				Return for repair/ Replace	One or both internal wires are open or short circuit.
3. Line mode: Locator does not detect signal				Return for repair/ Replace	One or both internal wires are open or short circuit.
Tested by:					Date:

A.4   Sonde Functional Check

Checking the Function

The purpose of the following procedure is to enable a user to verify the performance of the Sonde.

To carry out this test the following are required:

• A Locator to detect the signal.
• A work area free of services as illustrated.

1.Inspection
  • Casing   The casing should be free of significant damage, with the sealing ring and the screw thread intact

Once the general condition of the Sonde is established the self test can then be used to indicate the basic unit function and state of the batteries.

2. LED test
Turn on the sonde, the led display will illuminate.

3. Battery check
A dull LED, and lack of detection range will indicate poor battery condition. Use alkaline batteries.

1. Switch sonde on and activate 33kHz mode.
2. Set Locator to 33kHz mode and aim at Sonde (see diagram).
3. At 2m/6.56ft the Locator must be at maximum.
4. Repeat this with Sonde and Locator in 8kHz.
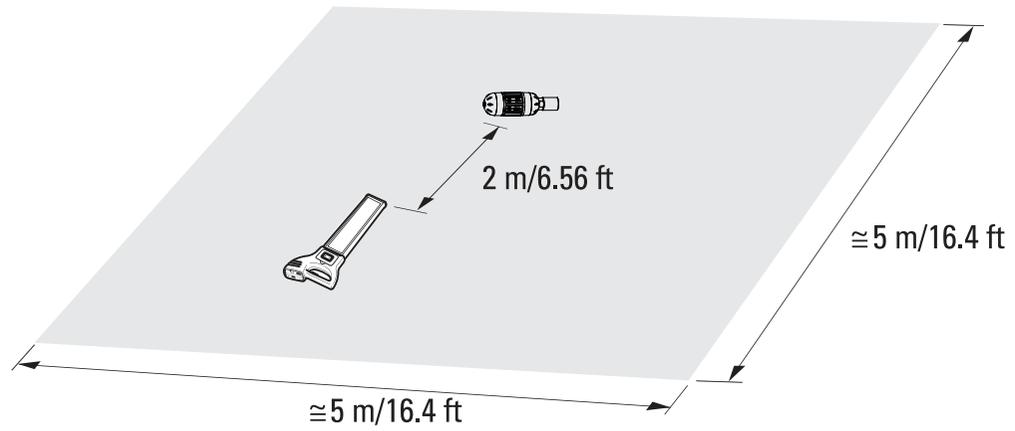
2 m/6.56 ft

≅ 5 m/16.4 ft

≅ 5 m/16.4 ft

☞ **If any of these tests give no response or a significantly different response from normal, the Sonde should be returned for service.**

Functional test check list

Functional test check list					
Unit: Conductive Rod...	Serial Number:		Comments:		
Test	Operative			Fail analysis	Notes
	Yes	No	N/A		
1. Casing				Fail	Casing should be free of damage.
2. Screw thread and seal				Fail	Screw thread must be intact and seal in place.
3. Battery contacts				Fail	Contacts must be free of corrosion.maximum display at 2metres.
4. 33 kHz mode				Fail	LED must be illuminated brightly and pulse fast. Locator must provide maximum display at 2 metres.
5. 8 kHz mode				Fail	LED must be illuminated brightly and pulse slowly. Locator must provide maximum display at 2metres.
Tested by:					Date:

Appendix B World Frequency Zones

North America		South America	
Canada	120 V / 60 Hz	Argentina	230 V / 50 Hz
United States	120 V / 60 Hz	Bolivia	110 V / 50 Hz
Mexico	120 V / 50 Hz, 60 Hz	Brazil	110-127-220 V / 60 Hz
		Chile	220 V / 50 Hz
Central America		Colombia	110-220 V / 60 Hz
Bahamas	115 V / 60 Hz	Ecuador	110-220 V / 60 Hz
Barbados	115 V / 50 Hz	French Guiana	220 V / 50 Hz
Belize	110-220 V / 60 Hz	Guyana	110-240 V / 60 Hz
Bermuda	115 V / 60 Hz	Paraguay	220 V / 60 Hz
Costa Rica	120 V / 60 Hz	Peru	220 V / 60 Hz
Cuba	115-120 V / 60 Hz	Surinam	110-127 V / 60 Hz
Dominican Republic	110-220 V / 60 Hz	Uruguay	220 V / 50 Hz
El Salvador	120-240 V / 60 Hz	Venezuela	120-240 V / 60 Hz
Guatemala	115-230 V / 60 Hz		
Haiti	110-220 V / 60 Hz	Australia, Oceania	
Honduras	110-220 V / 60 Hz	Australia	240 V / 50 Hz
Jamaica	220 V / 50 Hz	Fiji Islands	240 V / 50 Hz
Netherland Antilles	110-127 V / 50 Hz	New Zealand	230 V / 50 Hz
Nicaragua	120 V / 60 Hz	Solomon Island	240 V / 50 Hz
Panama	120 V / 60 Hz	Tonga	230 V / 50 Hz
Puerto Rico	120 V / 60 Hz		
Trinidad & Tobago	115-230 V / 60 Hz		
Virgin Islands	120 V / 60 Hz		

Europe		Portugal	230 V / 50 Hz
Albania	230 V / 50 Hz	Romania	230 V / 50 Hz
Austria	230 V / 50 Hz	Russia	230 V / 50 Hz
Belgium	230 V / 50 Hz	Slovakia	230 V / 50 Hz
Belarus	230 V / 50 Hz	Slovenia	230 V / 50 Hz
Bulgaria	230 V / 50 Hz	Spain	230 V / 50 Hz
Croatia	230 V / 50 Hz	Sweden	230 V / 50 Hz
Czech Republic	230 V / 50 Hz	Switzerland	230 V / 50 Hz
Denmark	230 V / 50 Hz	Ukraine	230 V / 50 Hz
Estonia	230 V / 50 Hz	United Kingdom	230 V / 50 Hz
Finland	230 V / 50 Hz	Yugoslavia	230 V / 50 Hz
France	230 V / 50 Hz		
Germany	230 V / 50 Hz		
Greece	230 V / 50 Hz		
Hungary	230 V / 50 Hz		
Iceland	230 V / 50 Hz		
Ireland	230 V / 50 Hz		
Italy	230 V / 50 Hz		
Latvia	230 V / 50 Hz		
Lithuania	230 V / 50 Hz		
Luxemburg	230 V / 50 Hz		
Moldavia	230 V / 50 Hz		
Netherlands	230 V / 50 Hz		
Norway	230 V / 50 Hz		
Poland	230 V / 50 Hz		

Africa		Mauritius	230 V / 50 Hz
Algeria	127-220 V / 50 Hz	Morocco	127-220 V / 50 Hz
Angola	220 V / 50 Hz	Mozambique	220 V / 50 Hz
Benin	220 V / 50 Hz	Namibia	220 V / 50 Hz
Botswana	220 V / 50 Hz	Niger	220 V / 50 Hz
Burkina Faso	220 V / 50 Hz	Nigeria	230 V / 50 Hz
Burundi	220 V / 50 Hz	Rwanda	220 V / 50 Hz
Cameroon	127-220 V / 50 Hz	Senegal	110 V / 50 Hz
Central Africa Rep.	220 V / 50 Hz	Sierra Leone	230 V / 50 Hz
Chad	220 V / 50 Hz	Somalia	220 V / 50 Hz
Congo	220 V / 50 Hz	South Africa	220-240 V / 50 Hz
Dahomey	220 V / 50 Hz	Sudan	240 V / 50 Hz
Egypt	220 V / 50 Hz	Swaziland	220 V / 50 Hz
Ethiopia	220 V / 50 Hz	Tanzania	230 V / 50 Hz
Gabon	220 V / 50 Hz	Togo	127-220 V / 50 Hz
Gambia	230 V / 50 Hz	Tunisia	127-220 V / 50 Hz
Ghana	240 V / 50 Hz	Uganda	240 V / 50 Hz
Ivory Coast	220 V / 50 Hz	Zaire	220 V / 50 Hz
Kenya	240 V / 50 Hz	Zambia	220 V / 50 Hz
Lesotho	220-240 V / 50 Hz	Zimbabwe	220 V / 50 Hz
Liberia	120 V / 60 Hz		
Libya	115-220 V / 50 Hz		
Malawi	230 V / 50 Hz		
Mali	220 V / 50 Hz		
Mauritania	220 V / 50 Hz		

Asia		Laos	220 V / 50 Hz
Abu Dhabi	230 V / 50 Hz	Lebanon	110-220 V / 50 Hz
Afghanistan	220 V / 50 Hz	Malaysia	240 V / 50 Hz
Armenia	220 V / 50 Hz	Myanmar	240 V / 50 Hz
Azerbaijan	220 V / 50 Hz	Oman	240 V / 50 Hz
Bahrain	110-230 V / 50 Hz, 60 Hz	Pakistan	230 V / 50 Hz
Bangladesh	230 V / 50 Hz	Philippines	110-220 V / 60 Hz
Brunei	240 V / 50 Hz	Qatar	240 V / 50 Hz
Cambodia	220 V / 50 Hz	Saudi Arabia	127-220 V / 50 Hz
China	220 V / 50 Hz	Singapore	230 V / 50 Hz
Cyprus	240 V / 50 Hz	Sri Lanka	230 V / 50 Hz
Georgia	220 V / 50 Hz	Syria	220 V / 50 Hz
Hong Kong	220 V / 50 Hz	Taiwan	110-220 V / 60 Hz
India	230-250 V / 50 Hz, 60 Hz	Tajikistan	220 V / 50 Hz
Indonesia	127-220 V / 50 Hz	Thailand	220 V / 50 Hz
Iran	220 V / 50 Hz	Turkey	220 V / 50 Hz
Iraq	220 V / 50 Hz	Turkmenistan	220 V / 50 Hz
Israel	230 V / 50 Hz	United Arab Emirates	220 V / 50 Hz
Japan	100-220 V / 50 Hz, 60 Hz	Uzbekistan	220 V / 50 Hz
Jordan	220 V / 50 Hz	Vietnam	120-220 V / 50 Hz
Kazakhstan	220 V / 50 Hz	Yemen	220 V / 50 Hz
Kirgizstan	220 V / 50 Hz		
Korea (North)	220 V / 50 Hz		
Korea (South)	110-220 V / 60 Hz		
Kuwait	240 V / 50 Hz		
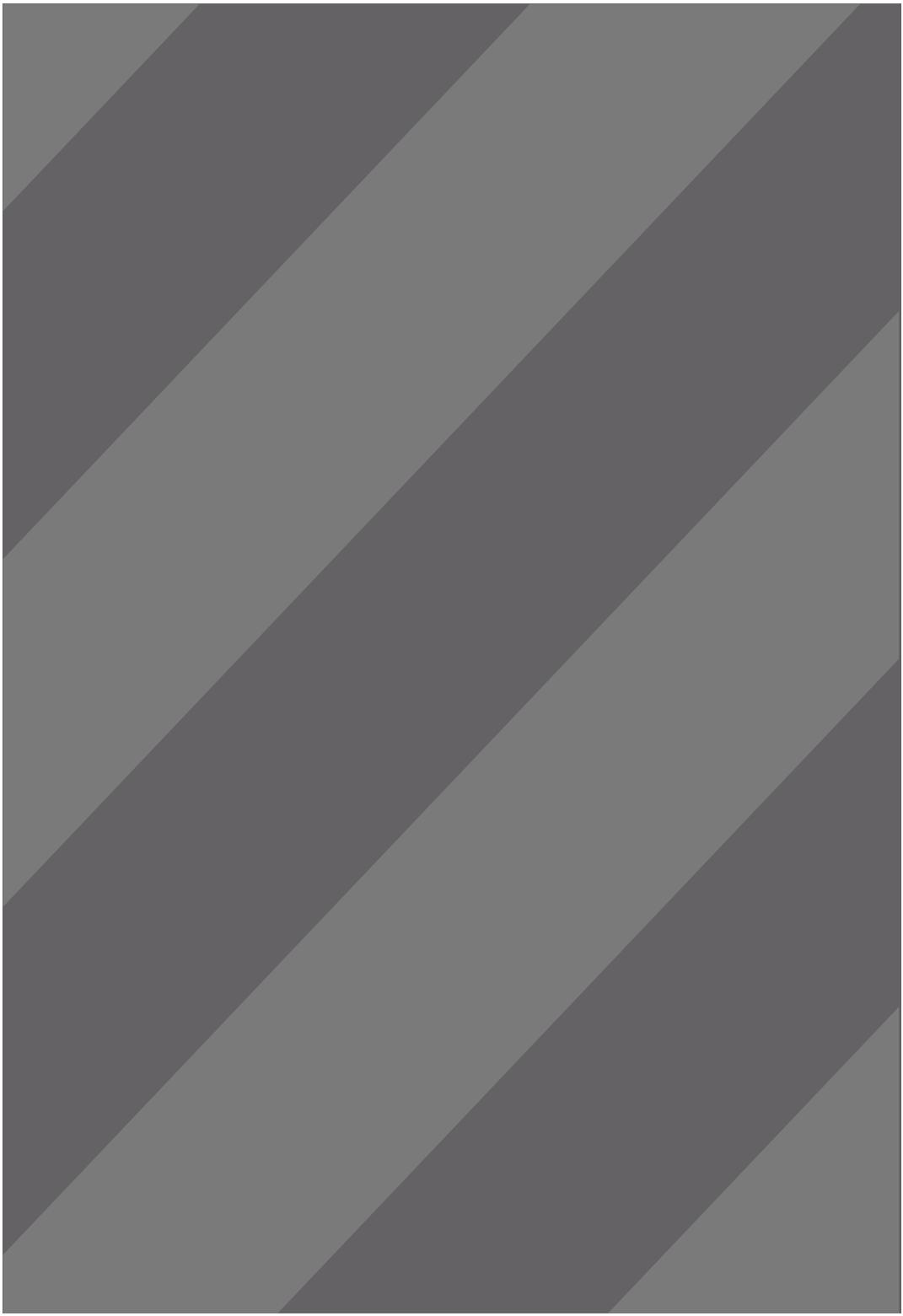
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