



PAL 300 - Personal Automatic Leakfinder

Quick Manual

The handling of the instrument is to a great extent self-explanatory. However, should you have any problems or questions, please contact our local customer service.

The system components

The Automatic Leak-finder consists of the following system components:

- 1 x PAL 300 central unit
- 1 x PAL Link transmitter unit
- 2 x high sensitivity sensors with magnetic fixtures
- 2 x antennae
- 1 x headphones
- 1 x battery charger

Principle of automatic leak location with the PAL 300

A water leak creates a noise which propagates on the pipe to both sides of the leak. This noise is picked up by highly sensitive sensors, which are placed directly on the pipe on easily accessible spots (e.g. valves, hydrants, house connections). The central unit compares the noises picked up by both sensors, and measures the time delay of the noise reaching the sensors.

However, you really should not bother with the highly complicated signal processing and the involved mathematics. The PAL 300 will simply tell you how far away the leak is situated from the PAL 300 and from the PAL Link. To enable the PAL to calculate the result, you only have to enter first a few leak specific inputs. But for this, just follow the instructions on screen.

Normally leak location is commenced by connecting the PAL Link.

Connecting and using the PAL Link

On the right hand side of the PAL Link you will find 3 connectors. The lowest connector is reserved for the sensor. The middle connector serves for the battery charger. The upper connector accommodates the headphones.

First, you have to insert the sensor into the bottom connector. Please remove the protecting cover on the magnet fixing (otherwise the noise to be picked up will be

insufficient). Make sure that the sensor has a very good contact with the pipe. One of the most important factors for success is a good and correct reception of the leak noise!!

Insert the antenna into its socket on the top end of the instrument. Besides the socket there is a round push-button to switch on the instrument, as well as an LED which indicates the functioning of the PAL Link. When pressing the button briefly, the instrument is switched on and the LED will single flash. When pressed for a second time, the LED will double flash.

When locating a leak, the following selection is required:

- (a) The single flash mode is to be used for all metallic and (asbestos) cement pipes.
- (b) The double flash mode is to be used for all plastic pipes (MDPE and uPVC).

The PAL Link is switched off by pressing the start/stop button again for at least 2 seconds.

Connections and Keys of the PAL 300

The connectors of the PAL 300 correspond with those on the PAL Link. When holding the instrument horizontally, the connectors are on the upper side of the instrument. The left hand connector is to be used for the sensor, the connector in the middle is reserved for the battery charger and the connector on the right hand side serves for the headphones. It is not possible to connect to the wrong sockets, as the plugs are not identical and can only be plugged into the correct sockets.

Starting from left you will find the following 8 keys:

- With the first key on the left hand you can switch the instrument on and off (keep the key briefly pressed).
- The next key serves to switch on and off the back light. Please note that the battery charge cycle lasts double without backlight.
- When pressing the ?-key, the telephone and fax numbers of your hot-line will appear on screen.
- With the help of the M-key you can switch over to the main menu at any time.
- The ↑ and the ↓ keys serve for the selection of the appropriate material or diameter, the correct distance or the desired option.
- The second last key (X) serves to cancel the last enter.
- The ✓-key on the right hand side is the so-called "enter key". Each selection must always be confirmed with the ✓-key.

How to locate a leak?

Switch on the PAL 300 (keep the first key on the left hand side briefly pressed). The starting screen will appear, indicating the program version.

Press the OK-key (right hand side). The PAL 300 will now ask you to connect the sensors and to switch on the PAL Link (see reference above). As soon as you have fulfilled each request, the PAL answers with an "ok".

Now press the ✓-key. The PAL 300 will move to the next screen, where you enter the pipe specifications. You can select between entering the material or the sound velocity (with the ↑ or the ↓ key). Normally, the user will now enter the pipe material (select with the arrow keys). The displayed pipe indicates the material of the last measurement. The list of materials can be selected by using the arrow keys and confirmed with the ✓-key.

Now the diameter has to be entered. Again, the diameter entered for the last measurement will appear. The desired diameter is selected by using the arrow keys and confirmed with the ✓-key.

The PAL 300 will now automatically change to a new screen, where the distance between the two sensors has to be entered. The indicated value can be increased or decreased by keeping the arrow keys pressed. Keep the key pressed until the correct value is reached (the longer the key is pressed, the faster the values will change). Again, the correct value is confirmed with the ✓-key.

The PAL 300 will now ask whether to start the measurement. Confirm with the ✓-key. After beginning the measurement, a bar showing the state of the measurement will appear (in % of the total measurement time). Above the bar the quality of the radio connection is indicated. The PAL will stop the measurement automatically. The measured pipe section will be displayed on the screen, showing the position of the leak and its distance from the PAL300 and from the PAL Link. The quality of the measurement will also be displayed in % as an overall rating (good, unsatisfactory, etc.). Further comments on the measurement quality can be found on the following screens.

Press the ✓-key: to find a comment on the measurement accuracy. The accuracy of the calculation mostly depends on the position of the leak on the measured pipe section. If the leak is in the middle between the two sensors, the accuracy is very high. The nearer the leak to one of the sensors, the higher the uncertainty. There are 3 possible ratings depending on the leak position: possible deviation less than 0.5 m, between 0.5 and 1 m, or more than 1 m.

Press the ✓-key again: a detailed comment on the measurement quality will appear on screen. (See special paragraph). When pressing the OK-key once more, the main menu and the indication of the battery charge will appear on screen.

How to measure a pipe section which consists of more than a single pipe material or diameter.

The list of pipe materials also offers the option of "mixed material", in case the pipe section to be investigated consists of more than one material or diameter. When you select this option, the above-described procedure is slightly different. First the number of subsections between the two sensors (maximum 6) should be entered. The pipe displayed on screen will now show the number of subsections, highlighting each time the specific subsection to be specified. For each subsection it is necessary to enter the length, the material and the diameter. As soon as you have defined all the subsections, the PAL will automatically change to the next screen.

The main menu

The main menu offers a selection of the four following options:

- Enter distance or material
- Leak location
- Load stored measurement
- Setup

The first two menu options allow further measurements, either after changing the distance and/or the pipe material (see respective description above) or a repetition of the last measurement without having to confirm the last entries.

Automatic storage of measurements

The PAL automatically stores each measurement. The memory capacity is 30 measurements. The memory is organized in a way that the oldest measurement is deleted when the newest measurement is stored in the memory. The last measurement will always appear on top of the list, then the second last and so on. The PAL stores the measurement result as well as the comments about its precision and quality. The memory can neither be deleted nor printed out.

Setup

It is possible to change the following setup details:

- Date and time
- Duration of measurement (there is normally no need to change the standard setting 6)
- Display contrast
- Signal filter 150 Hz (only for test purposes, should not be changed by the user)
- Language

What does measurement quality mean?

The automatic leak location is a very complex mathematical procedure with numerous analyses, all of which run in the background without ever disturbing the user. The PAL constantly verifies the quality of the measurement conditions and whether the result is plausible. During this procedure the PAL collects many samples and adds each to the previous sum. Due to various reasons, especially as also small leaks have to be located, the PAL is programmed to show a measurement result even if there is no leak. Therefore the PAL constantly verifies the quality of the result of each single sample and whether it always leads to the same result. The final result of all these verifications will then be displayed as *measurement quality*. External influences can cause accidental results. It is therefore highly recommended to repeat the automatic leak location 2-3 times.

If the measurement quality is repeatedly rated as unsatisfactory or insufficient, you can assume that there is no leak present. An unsatisfactory measurement quality will of course also be displayed in the following cases:

- if the radio connection is not satisfactory
- if the leak noise is so weak that it is not picked up by one of the sensors
- if one of the sensors is not well fitted on the pipe (insufficient contact)
- if other ambient noise sources on the pipe section disturb the measurement (for example: pump noise).

If, however, several consecutive measurements show the same result and the measurement quality is displayed around 90% (88-92%), this means that the probability of a correct leak location is very high.

Useful tips for successful measurements with the PAL

- The sensors must always be attached to a spot which has direct contact with the pipe. Otherwise the leak noise cannot be picked up; i.e. no measurements in a valve box which is not clean. Also, do not attach the sensors to the outer housing of a hydrant, but directly on the hydrant valve rod.
- The spot where the sensor will be placed has to be absolutely clean. Always clean it before attaching the sensor.
- It is recommended to always use the headphones after connecting the sensor. The user can then easily verify whether there is a leak noise present or not. Without the presence of a leak noise, even the PAL is unable to locate a leak.
- The use of headphones during leak noise measurements is recommended. This enables the user to recognize immediately the presence of any problem or disturbance.
- When the measurement points to any kind of pipe connection or crossing (for example: a house connection), then it can normally be assumed that the leak is not where indicated, but on the connecting pipe section. The PAL cannot calculate a leak which is not directly on the pipe section under investigation, but will indicate the position where the leaking pipe is connected (T-junction). One of the sensors should then be transferred to the connecting pipe (e.g. near the water meter on a house connection) and the measurement should be repeated.
- Each point of water consumption creates a noise very similar to a leak noise. When the measurement result pinpoints a house connection, verify whether a meter is running.
- The PAL is unable to locate a leak that is outside the measured pipe section. When the result shows a negative value, then the neighboring pipe section should also be investigated, for example: by placing one sensor further down the direction of the negative value.
- Measurement results near the centre of the measured pipe sections are quite accurate. The nearer the leak position to one of the sensors, the less accurate the calculation. When the indicated leak position is on the outer third of the pipe

section, it is recommended to verify the precise position with a ground microphone or to move one of the sensors to another position so that the leak then would be in the middle section of the investigated pipe.

Instrument maintenance / Charging the batteries

The PAL 300 does not need any maintenance, nor is any periodic recalibration necessary. It is only necessary to recharge the batteries. The battery life cycle is more than 1500 working hours; which means more than 5 years of normal use.

The batteries in the PAL 300 and the PAL Link are lead-acid batteries. Unlike lithium and other types of batteries, the lead-acid batteries have no so-called memory effect, but could be damaged when totally discharged. The batteries should never be totally discharged. Recharging the batteries, even when they are not yet discharged, does not harm them, nor would it shorten their life cycle.

The battery charger has two plugs to accommodate the PAL 300 in addition to the PAL Link for recharging at the same time. The battery charger has a red LED which remains illuminated until both batteries are fully charged. Additionally, the battery charger is equipped with a protection against overcharging. The batteries can remain connected to the electricity socket for unlimited periods of time without any risk of possible damages. It is therefore recommended to recharge the batteries after each use.