

LEAKSHOOTER®

LEAK DETECTION CAMERA

LKS1000-V3

www.synergys-technologies.com

LKS1000-V3
USER MANUAL
VERSION 1.3



WHAT IS THE LEAKSHOOTER® LKS1000-V3 ?

LEAKSHOOTER® LKS1000-V3 is a portable detection device that offers the possibility to hear, measure, view and record leaks which emit ultrasounds.

Main functions :

- Detection and location of ultrasound via an automatic and dynamic target
- Listening to ultrasound by heterodyne principle (40 kHz > 2.5 kHz)
- Measurement and display of the RMS and RMS MAX values in real time on a coloured bar graph
- Viewing the presence of ultrasound on the screen (place of the leak)
- Saving the photo in the memory with all its date and measurement information
- Steam Trap analysis with integrated ultrasonic US and temperature T° sensors and STRAPSHOOTER® firmware

LEAKSHOOTER® LKS1000-V3, the first ultrasound detection camera for leak detection, steam trap analysis, designed and developed by LEAKSHOOTER®, a department of SYNERGYS TECHNOLOGIES (France).

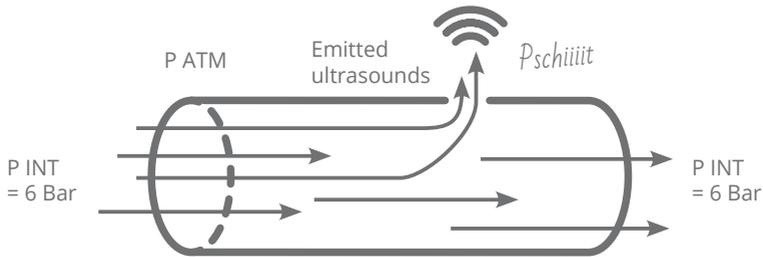
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ULTRASONIC TECHNIQUE TO FIND GAS LEAKS

COMPRESSED AIR OR OTHER GASES UNDER PRESSURE / VACUUM

When a gas goes from a high pressure state (compressed in a pipe at 6 bars for example) to a low pressure state (leak in a line, with external atmospheric pressure), there is a phenomenon of depression, which creates turbulences.



These turbulences generate a wide spectrum of noise including ultrasound, due to the friction of the gas molecules (air for example) through the hole.

The human ear hears up to about 20 kHz.

Therefore, the human ear does not hear the ultrasound from about 20 kHz to 100 kHz.

That is why, by using sensors sensitive to these ultrasounds, associated to a heterodyne technique often centred around 40 kHz, it is possible to find and hear the leaks easily.

Why are ultrasonic waves easy to find with an ultrasound detector ?

They are highly directional, emitting in a specific direction.

They generate a high intensity ultrasound at their emission source, which decreases rapidly when further away from the source.

They can be heard by heterodyne technique (high frequency signal demodulation type here, ultrasound inaudible to the human ear) in low frequency signals (audible to man, here at about -2.5 kHz)

They can be detected in a noisy environment (non-ultrasound), because they are properly filtered by the detector.

This ultrasonic technology has the advantage of being accessible to all by its ease of use.

DESCRIPTION OF LEAKSHOOTER® LKS1000-V3



DETAILS OF THE LEAKSHOOTER® LKS1000-V3 KIT

ABS transport case
Ultrasonic detection camera
Anti-noise headphones with jack cable (SNR 31)
Universal battery charger
USB cable for PC
User manual

LKSCASEABS
LKS1000-V3
LKSEAR
LKSPower
LKSUSB
LKSMANUAL



Optional flexible ROD of 400 mm or 1500 mm and contact probe for LKS1000-V3.



BATTERY CHARGING

LEAKSHOOTER® LKS1000-V3 is equipped with a Lithium-ion battery. Its capacity is about 6 hours of battery life, depending on the settings of the appliance (camera activated or not, screen brightness, etc.).

It must be recharged exclusively with the charger provided in the kit (5V DC, 2A) or with an universal USB 5V DC, 1 or 2A power supply (PC USB, car adapter USB) or with the spare LKS BATT external USB battery (optional) allowing more than 15 hours of autonomy.

The charging time is about 5 hours.

ATTENTION !

Please take notice of the messages on the LEAKSHOOTER® LKS1000-V3 about instructions on the status of the battery.

LEAKSHOOTER® LKS1000-V3 is automatically switched off, when the battery voltage is too low (flat battery).

Please charge the battery when the appliance requires it to get the best battery life.

IMPORTANT :

If you think you will not use the LKS1000 for more than a month, please recharge it completely before storing it !

SWITCHING ON AND OFF

Switching on

Press the button  1 seconde, LEAKSHOOTER® LKS1000-V3 starts 1-2 seconds after initialization.

Switching off

Press for a longer time (1-2 seconds) the button , LEAKSHOOTER® LKS1000-V3 is switched off.

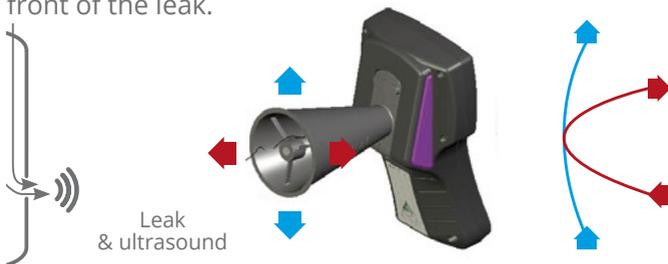
If the battery is flat, LEAKSHOOTER® LKS1000-V3 cannot be switched on. Recharge (about 5 hours).

PROCEDURE FOR FINDING A LEAK BY SCANNING TECHNIQUE WITH CONE

LEAKSHOOTER® LKS1000-V3 has been designed to display the fusion of images of the scene being scanned and the detected leak on the screen and in real time continuously (ultrasound received = dynamic target present). Depending on the size of the leak (intensity of ultrasonic waves received around 40 kHz), the dynamic target will be in yellow or red colour. LEAKSHOOTER® LKS1000-V3 is equipped with a special MAX value function which thanks to the target shows you if you are close to the leak (simple square target) or in front of the leak (square target and cross in the centre). The method consists of scanning the scene, conscientiously.

MANUAL GAIN MODE : Default mode when switching on the LEAKSHOOTER® LKS1000-V3

This mode will be used primarily when searching for small, medium and large leaks. Start with the maximum of sensitivity (GAIN=110 DB, set when the appliance is switched on). Sweep the scene for example from left to right and from top to bottom, with the aim of going in front of the leak and thus activating the special MAX value, which will remain frozen a few seconds (bold vertical line in the colour bar graph). If you still have the red target, everywhere, it is because you are in a saturated area. Slightly lower the GAIN and start again in such a way as to find a direction in which to go. Thus, go back to the area to find this special MAX value (align RMS real time and MAX). You will see a cross in the centre of the dynamic target square. You are in front of the leak.



PROCEDURE FOR SEARCHING FOR THE LEAK WITH THE FLEXIBLE ROD (OPTION)

When you are working on places where access is difficult or on small connectors, fittings, etc., it is more efficient to work with the 400 mm or 1500 mm flexible rod than with the cone.

You will work in MANUAL mode as previously.

Locate the leak with the rod, and then point the camera in the direction of the end of the rod to take a photo of the location of the leak.

REMARK :

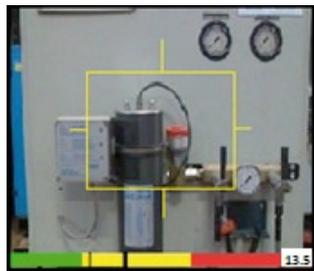
You can use the headphones at any time. You can then hear the detected leak.

DIFFERENT POSSIBLE MEASUREMENT SCREENS

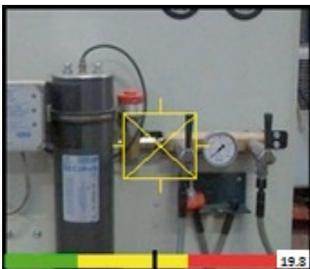
Case no. 1 : No leak



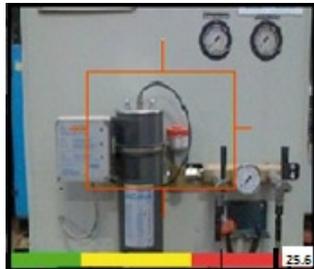
Case no. 2 : Close to small leak



Case no. 3 : Facing a small leak



Case no. 4 : Close to a major leak (medium and large)



REMARK : The more the RMS value approaches the MAX value, the more the target bunches up in its centre.

Case no. 5 : Faced with a significant leak



Remarks for these 5 different possibilities :

It is possible to adjust the volume in the headphones during the measurement. Click the up and down buttons of the keyboard joystick (volume adjustable from 0 to 10). Be careful not to remain at high volume for a long period !

The standard volume is 3-4 /10.

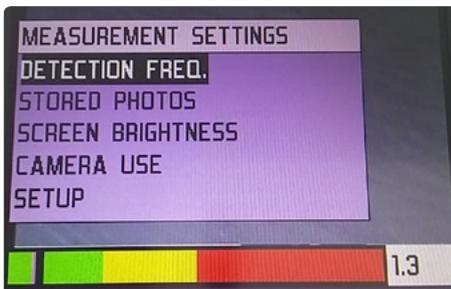
Synergys Technologies will in no case be responsible for hearing problems in the case of intensive use and high volume of the headphones.

Thanks to the efficiency of the LEAKSHOOTER® LKS1000-V3 dynamic real time target, MAX and RMS values), it is possible to do without the headphones.

MENU AND SETTINGS

The menu of the LEAKSHOOTER® LKS1000-V3 is accessible by the key  on the keypad.

You then access : up and down buttons, escape with the key .



- Freq.Detection : Frequency of the kHz mixer (variable from 34 to 46 kHz)

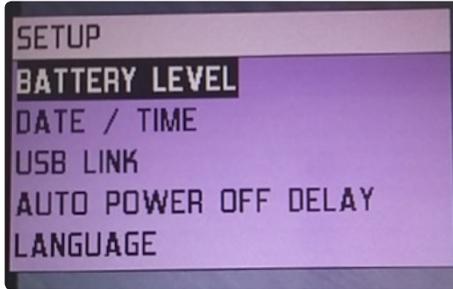
Defaut Fmixer is 41,5 kg for use with cone and flexible. For use with contact probe, use written delivered paper value $\pm 0,1$ kHz.

- Stored Photo taken : To view photos stored in the memory of the LKS1000-V3

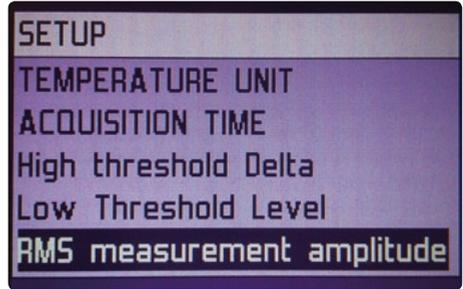
- Screen brightness (0 to 10)

- Camera use : Deactivation/activation of the camera, to save the batteries.

If you continue to go down after « Use camera », you can go to SETUP, click it with **Valid.Menu**. To browse through the menu, use the up and down keys of the keypad. To modify and confirm a setting, click **Valid.Menu**. To exit the menu, click **ESC**.



BATTERY LEVEL: Voltage and approximate % of use of the battery
DATE / TIME
USB CONNECTION: to establish the connection with the PC
AUTOMATIC cut-off time
LANGUAGE (French, English, German)



RMS MEASUREMENT AMPLITUDE: Selection of amplitude scale for graphic in Real Time (0-30 ; 10-40 ; 20-50 ; 30-60 ; 40-70 ; 50-80 dB)
TEMPERATURE UNIT: °C or °F
ACQUISITION TIME: 30, 60, 90, 120s for Auto Diagnose
HIGH TRESHOLD DELTA: Threshold delta to detect "OPEN" condition (normally "2")
LOW TRESHOLD LEVEL: Treshold level to detect "CLOSED" condition (normally "REAL TIME lowest level + 2dB")

TAKING PHOTOS WITH THE LEAKSHOOTER® LKS1000-V3

Saving a photo

A / When you are in front of the leak (target and cross at the centre, RMS=MAX), click once on **Photo**. The image is frozen and ready to go into the memory. You can still exit (Esc) and not save this photo by clicking on **ESC**.

B / Otherwise, click a second time on **Photo**. The image is ready to be digitised. The image receives a number (default number) then is time stamped.

C / Then click on **Valid.Menu**, the image is saved.



A



B



C

Deleting a photo

(Escape is always possible before confirming the action !)

To erase all the photos, choose one in memory : Menu/Photos taken and confirm and then press **+** for 2 seconds, confirm **Valid. Menu** will erase all the photos.

To delete a single photo, choose one in memory : Menu/Photos taken and confirm and then click **📷**. Confirm **Valid. Menu** to delete the photo.

If there is no photo in memory, a message « No photo » appears.

HOW TO UNLOAD THE PICTURES INTO THE PC ?

Only for standard leak detection, not for STRAPSHOOTER®.

Connection of the LEAKSHOOTER® LKS1000-V3 to the WINDOWS PC via an universal usb connection type USB MASS STORAGE

No PC software or driver to install

PC with WIN XP/VISTA/7/8/10 + LKS1000-V3 (Off) + USB cable

Description

The USB MASS STORAGE connection allows you to unload the photos from the LEAKSHOOTER® LKS1000-V3/LKS100 to archive them permanently in the PC.

Installation

Connect the LEAKSHOOTER® to the PC via the USB cable. Switch on the LEAKSHOOTER® LKS1000-V3.

Press the **Valid. Menu** key, go to Setup. Press the **Valid. Menu** key again.

Go to USB connection, press the **Valid. Menu** key. « USB connection in progress » appears on the screen.

The PC detects the appliance and opens a window to the screen showing the LEAKSHOOTER® LKS1000-V3 memory (USB MASS STORAGE). Inside are the photos in BMP format. Copy the photos to the PC (copy / paste).

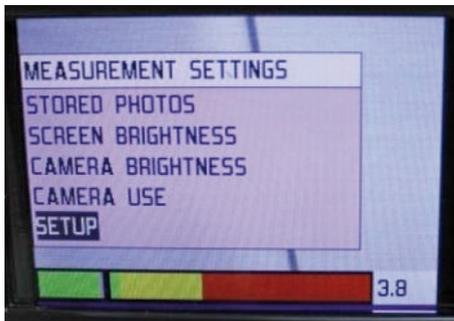
Attention, do not delete the pictures of the LEAKSHOOTER® LKS1000-V3 via the PC but via the appliance later. Please do not touch the NO ERASE directory.

You will also find a FOTOLIST file (.txt format) that you can also save. This is raw measurement data. **To exit this mode, disconnect the USB cable from the PC. The LKS1000-V3 restarts automatically.** You can continue to take measurements or switch off your appliance.

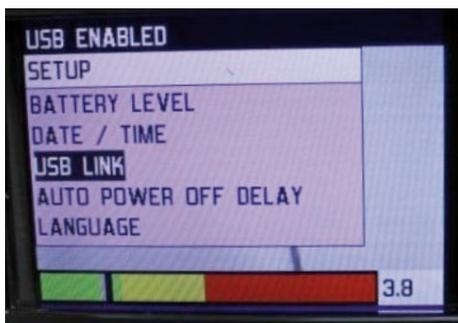
Connect the USB cable to the PC and switch on the LKS1000-V3.



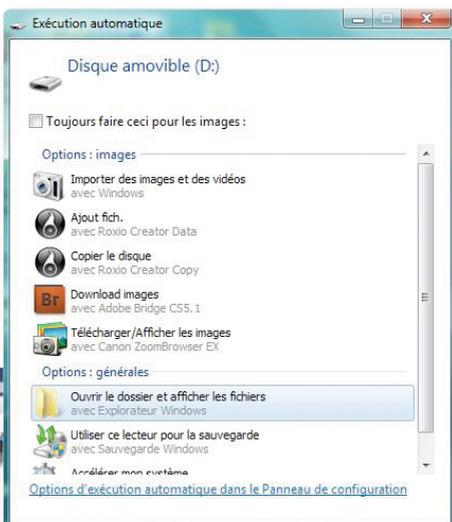
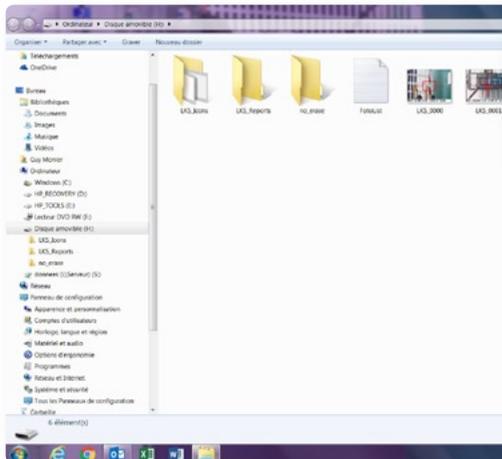
Go to the « Setup » line and confirm



Go to « USB Link » and confirm.
Wait a few seconds



Your PC displays the images on the screen.
Copy them. Delete photos via the LKS1000-V3, not via the PC !



STEAM TRAP PROGRAM : STRAPSHOOTER®

STEAM TRAP REAL TIME ANALYSIS & STEAM TRAP AUTO DIAGNOSIS PROGRAM

LEAKSHOOTER® LKS1000-V3 with integrated US and T° sensors has a special embedded firmware for STEAM TRAP SURVEYS: STRAPSHOOTER®. You can hear (with headphone) and see (with graphical curve) what happened inside your STEAM TRAP in real time (REAL TIME ANALYSIS) and you can also do an auto diagnosis to have a traceability of its condition state (AUTO DIAG).

- Connect the contact probe to your LEAKSHOOTER®.

Click on the STEAM TRAP button .

- Put the ultrasonic probe in contact with the STEAM TRAP main body near the discharge orifice location (without effort) and try to be stable as possible.

Per default, GAIN value is settled at 104 dB.

If necessary, adapt your RMS measurement Amplitude scale in MENU.

1. REAL TIME ANALYSIS

Select REAL TIME ANALYSIS  with the joystick keyboard (Fig. 1 > Fig. 2), click . Then, click on  when you are ready to measure. You see now the real time curve of the internal ultrasonic noise made by the STEAM presence in the TRAP.

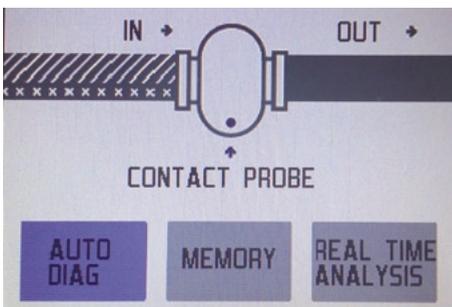


Fig. 1



Fig. 2

The complete time scale on the screen is 30s and is automatically refreshed, waiting whenever a click on **OK** to freeze it (Fig. 3). Then, you can measure T° in and T° out by moving always on right direction with **OK** button and **+** to measure T° . You can save all by clicking on **📷**. It will start again. You can escape with **-**.

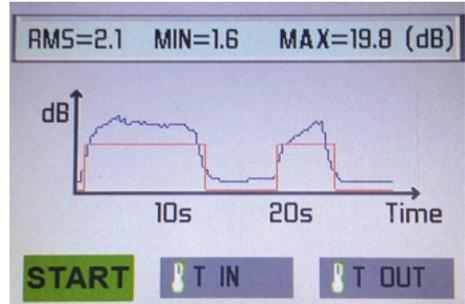


Fig. 3

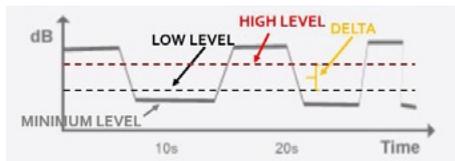


Fig. 4

Basically, you have to find clear CYCLES to have an **OK** condition. If you look a quasi-constant high or a quasi-constant low level of noise, you probably have **OPEN** or **CLOSED** condition (**to be confirmed with T° IN and T° OUT values**).

Before to do AUTO DIAG, please have a look on the minimum and maximum levels (dB) of this curve. Remain these values in dB. Leave the STEAM TRAP program by clicking on **🏠**, go to the main MENU of LEAKSHOOTER®, go to SETUP, go to **Low threshold level and High threshold delta**, change the values depending of your situation.

The best (to adapt depending of TRAP technology) is to add **2 dB** value to the minimum level (MIN) of your curve for the **Low threshold level and as High threshold delta** something between 1 to 5 dB (**2 dB is common**), depending of TRAP technology.

LEAKSHOOTER® will know now when you have **OPEN** or **CLOSED** situations (Fig. 4).

If you need to adapt GAIN (sensitivity) to avoid saturation, you can decrease GAIN value with **-** button during REAL TIME **REAL TIME ANALYSIS** or AUTO DIAG **AUTO DIAG**.

2. AUTO DIAG

After making the REAL TIME ANALYSIS with the right settings (**Low threshold level and High threshold delta**), you can have a traceability of your analysis by doing an AUTO DIAGNOSIS. It will help you to store the STEAM TRAP photo with the condition situation ($US+T^{\circ}$).

Select the AUTO DIAG **AUTO DIAG** with the joystick keyboard (Fig. 1 > Fig. 2).

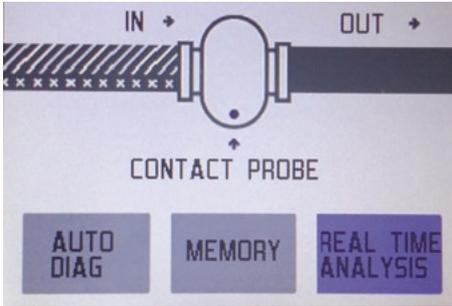


Fig. 1



Fig. 2



Fig. 5

Then, click on **OK** when you are ready to measure.

You see now the vertical real time bargraph of the internal ultrasonic noise made by the STEAM presence in the TRAP and the horizontal "Please wait" message (Fig. 5). AUTO DIAG time analysis can be 30, 60, 90, 120 and 300s long

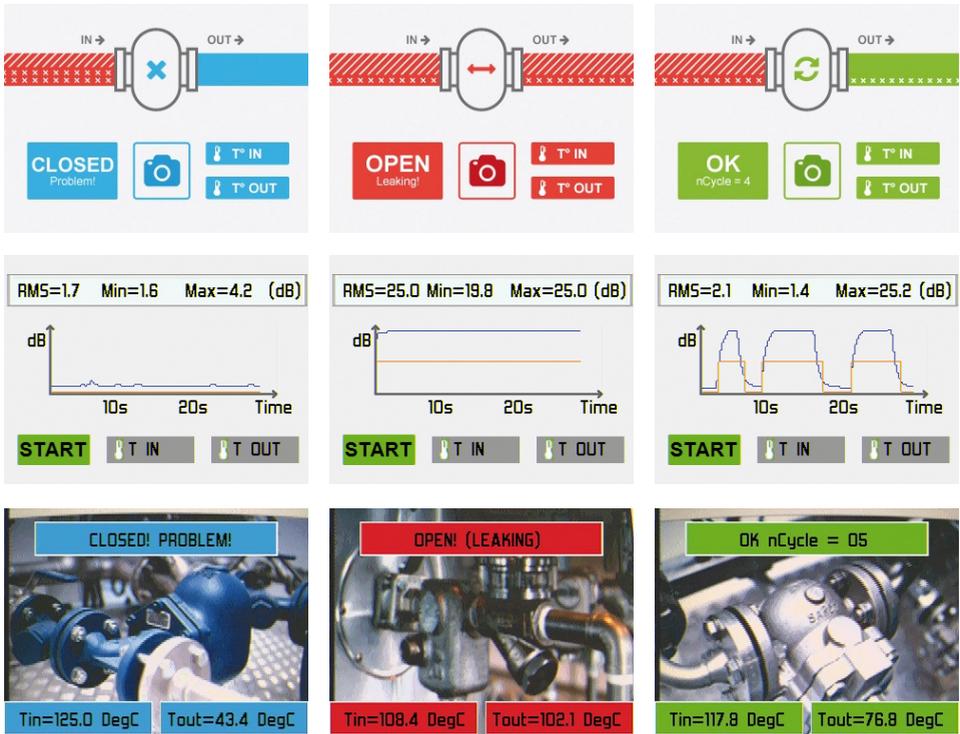
(settled in general MENU). This time duration will depend of your STEAM TRAP technology. We try to capture minimum "2 cycles OPEN-CLOSED". If you capture only 1 cycle, it will be necessary to change this time duration.

At the end of the AUTO DIAG, you can also measure (it is recommended) approximate $T^{\circ}IN$ and $T^{\circ}OUT$ (pipe temperatures in $^{\circ}C$ or $^{\circ}F$, see in the general MENU). We recommend around 0,15 meter distance for the best capture of the pipe T° . Measure and valid T° with OK. **If you have shiny pipe, use black matt adhesive tape for correct values (Emissivity!).**

Now, you can save all information in the memory by taking a photo of your STEAM TRAP with  and **OK**, x2 times (photo capture & memory).

See in the next page 3 results possibilities: **CLOSED-OPEN-CYCLING OK.**

Basically, you have to wait detection of an US cycle or modulation presence when you measure on a STEAM TRAP. Sometimes, it takes 1 minute or more, depending of trap technology and process.



- THERMODYNAMIC – MECHANICAL INVERTED BUCKET - THERMOSTATIC STEAM TRAPS are working with a “clear” ON-OFF cycle. > AUTO DIAG and REAL TIME can be used.

- MECHANICAL BALL FLOAT is more working with a “modulated” long cycle. Please check for this trap, the presence of real modulation (OK) and T°IN & T°OUT to be sure about condition. To confirm OPEN or CLOSED, its US signal should be low or high but constant, not modulated. > Only REAL TIME can be used, AUTO DIAG is not really adapted for modulation.

CLOSED means the TRAP is probably blocked in a closed position (to confirm with T°IN and T°OUT), it is very dangerous for the installation and human people (water hammer)!

OPEN means the TRAP is probably blocked in an open position (to confirm with T°IN and T°OUT), it costs a lot of money (ENERGY LOSSES).

CYCLING OK mean the TRAP is in a good condition.

CLASSIC CASES OF TRAP CONDITION:

US RESULT	T° IN	T° OUT	CONCLUSION
CLOSED? With constant US			Really blocked closed (careful-danger) Potential water hammer.
CLOSED? With constant US			Not in service (no steam presence)
CLOSED? With constant US			Evacuation of large amount of water (probably thermodynamic-thermostatic system OK). Check again later.
CLOSED? With modulated US			Evacuation of large amount of water (probably float machanical system OK). Check again later.
OPEN? With constant US			Really blocked open (energy losses)
OPEN? With constant US			Not in service (no steam presence). Probably US high noise level comes from other pipes
OPEN? With constant US			Evacuation of large amount of water (probably thermodynamic-thermostatic system OK). Check again later.
OPEN? With modulated US			Evacuation of large amount of water (probably float machanical system OK). Check again later.
CYCLING OK			Trap in good condition of work

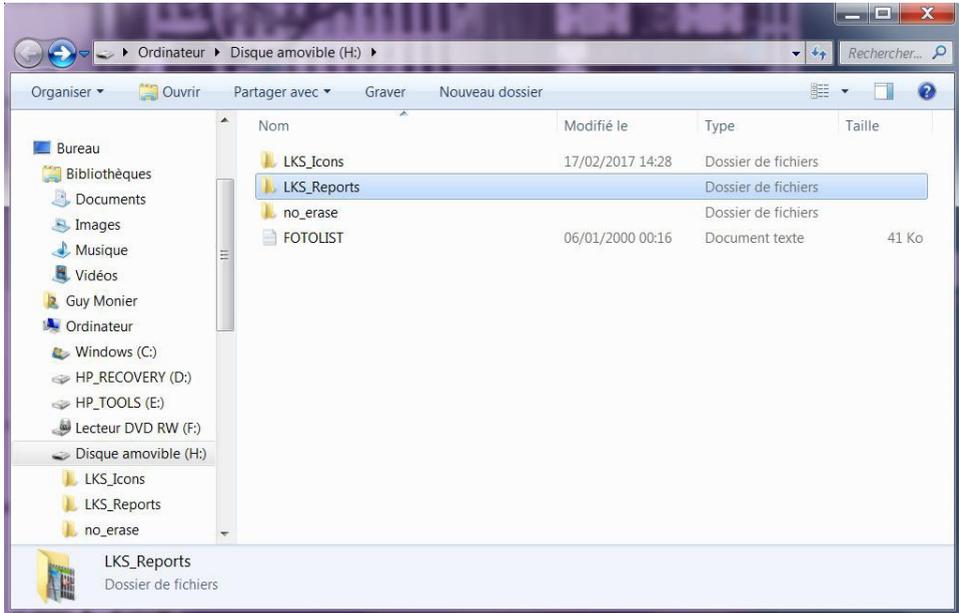
Steam T°	
Hot water T°	
No steam - No water	

3. MEMORY

You can review on the LEAKSHOOTER® screen all REAL TIME ANALYSIS or AUTO DIAG results via MEMORY . It is not possible here to delete files, just to review. **You need to connect LEAKSHOOTER® to PC if you need to delete STEAM TRAP files.**

3. DOWNLOAD FILES TO PC

You can review all REAL TIME ANALYSIS or AUTO DIAG results in **LKS REPORTS** directory. You are allowed to COPY/PASTE/DELETE these “BMP files” coming from this directory to your PC.



CAREFUL:

BMP photo files coming from LEAKSHOOTER® standard leak detection program (not from STEAM TRAP program) are located in a different directory than LKS REPORTS and cannot be deleted from the PC but from the LEAKSHOOTER® itself only (see in the user manual-HOW TO UNLOAD THE PICTURES INTO THE PC?). STRAPSHOOTER® BMP photo files coming from LKS REPORTS can be via USB link be COPIED/PASTED/DELETED to/from PC.

SYNERGYS TECHNOLOGIES has been established in 1996 in France, to offer innovative and professional solutions for preventive and predictive maintenance. SYNERGYS TECHNOLOGIES is the inventor of the ultrasonic visualization concept with the LEAKSHOOTER® and of the MCP (Machine Condition Picture) concept with the VSHOOTER®. We are present worldwide with professional and trained distributors.

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