Basis for measuring leakage in compressed air systems

Leakage detector LD 500/LD 510

Finding, quantifying and eliminating compressed air leaks

The LD 500 complies with the demands of class I Instruments of the standard "Standard Test Method for Leaks using Ultrasonic" (ASTM Int. - E1002-05)

"Every factory needs it, but hardly anyone knows that compressed air is one of the most expensive forms of energy. The rational use of compressed air therefore offers great potential for savings. Often the saving efforts are concentrated only on the compressed air generation, that is, on the compressors and the heat recovery".

Applications of compressed air:

- Process air
- Push button
- PET bottle production
- Looms
- Varnishes
- etc.

Compressed air is produced by compressing ambient air with a compressor. If impurities in the compressed air come into contact with the end product, this can lead to higher waste. This often turns a solution that seems inexpensive at first glance into a very expensive way of generating compressed air".

It is therefore indispensable for the user to treat the compressed air after it has been generated, as this air contains water, oil, dust particles and other impurities. Depending on the compressed air quality required, these ingredients can cause production problems and increase operating costs.

For processing, additional components must be provided in addition to the compressor, tank and piping system.

The air is dried with the aid of a dryer which, depending on the type of dryer, exudes more or less moisture and ensures a low dew point, depending on the specific use.

In addition, the compressed air should be cleaned of oil and particles with filters. The construction of an exemplary compressed air system is shown in Fig. 1.

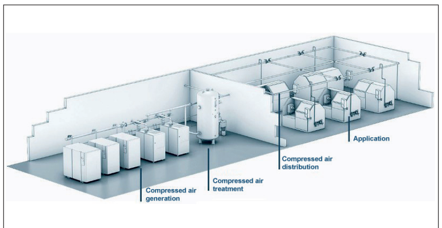


Fig. 1 Components of a compressed air system

The compressed air quality classes are specified by the ISO 8573-1 standard. By complying with the quality standards, the chance of machine failure is reduced, maintenance costs are reduced and the service life of the compressed air components is increased. The different quality classes are specified in **Fig. 1.**

CS Instruments supplies mobile and stationary measuring instruments for compressed air quality measurement in compliance with ISO 8573-1:

- Residual oil measurement the Oil Check 400 Residual oil measuring instrument
- Solid particles the PC 400 Particle measuring unit
- and for dew point measurement the FA 510 dew point meter

for the mobile and stationary DS 500 paperless recorders

Fig. 2: DS 500 paperless recorder with PC 400, Oil check 400, FA 510 dew point sensor

Druckluftqualitätsklassen nach ISO 8573-1 (Version 2010)

Class	Compressed air quality classes according to ISO 8573-1 (version 2010)				
	Dirt (solid particles) Max. Particle number per m³			Residual water	Residual oil
	0,1 < d ≤ 0,5 µm	0,5 < d ≤ 1,0 µm	1,0 < d ≤ 5,0 µm	DTP	mg/m³
0	specified according to application and better than class 1				
1	≤ 20 000	≤ 400	≤ 10	-70 °C	0,01
2	≤ 400 000	≤ 6 000	≤ 100	-40 °C	0,1
3	not specified	≤ 90 000	≤ 1 000	-20 °C	1,0
4	not specified	not specified	≤ 10 000	+3 °C	5,0
5	not specified	not specified	≤ 100 000	+7 °C	25

Example:	Compressed air of quality class 2.2.2 according to ISO 8573-1	
Particle:	max. 400 000 Particle	0,01 < Ø < 0,5 µm
	max. 6 000 Particle	0,5 < Ø < 1,0 µm
	max. 100 Particle	1,0 < Ø < 5,0 µm
Residual water:	min. Compressed air dew point -40 ° C	
Residual oil content:	max. 0,1 mg/m³	

Fig. 3: Compressed air quality classes

So if compressed and cleaned air escapes via leakages, additional costs arise because this air has to be produced additionally.

Fig. 4 shows the general cost distribution of a compressed air system.
The energy costs correspond with 73% to the highest share of the total costs.

The compressed air system must therefore be designed in such a way that the quantity and quality of the compressed air produced corresponds to the specification and that the system achieves the maximum achievable efficiency.

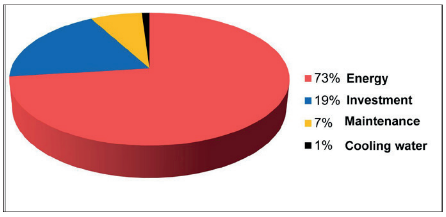


Fig. 5 lists the various savings potentials of the Fraunhofer Institute for the Compressed Air Industry. The highest savings potential is achieved by reducing the leakage rate.

By locating and eliminating leaks, 42% of the total savings potential of the compressed air system can be used.

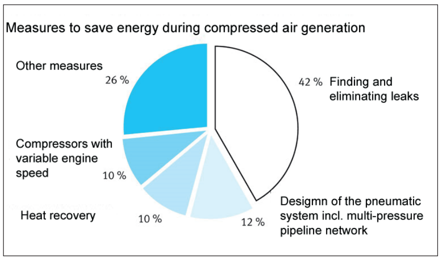


Fig. 5: Savings potential of a compressed air system

According to investigations by the Energy Agency NRW, a leakage rate of 30 % is not uncommon and leads to a pressure loss of up to 2 bar and 50 % of unused energy.

This is confirmed by a study conducted by the Fraunhofer Institute on behalf of Energie-Schweiz, which states that the leakage rate of manufacturing companies is between 15% and 70%.

When water escapes from a pipe, this is clearly visible. This is not so easy to detect with compressed air, as the typical “hissing” is only audible with very large leaks in a quiet environment.

However, with a usually high noise level in production halls, this can easily be ignored and the escaping air remains unnoticed. Often there is also ignorance as to how much costs are actually caused by compressed air leakages.

It is therefore recommended to carry out a leakage location regularly in order to find the large leaks and remedy them.

The energy management standard ISO 50001 defines a PDCA cycle to reduce companies' energy costs. This cycle can also be applied to the compressed air system.

The PDCA cycle leads to a continuous improvement of a considered quantity.

The cycle starts with an analysis of the initial situation and planning (plan) of solutions to implement concrete measures (Do).

The verification (check) is done by an evaluation of the degree of target achievement of the condition to be improved. In addition, the individual measures implemented are evaluated.

These findings are used to define further new improvement measures (Act) if the target has not been achieved.

Leakage location acts as a phase check tool for the compressed air system under consideration to ensure that it is working effectively.

If defects (leaks found) are discovered, then they should be remedied (Phase Act).

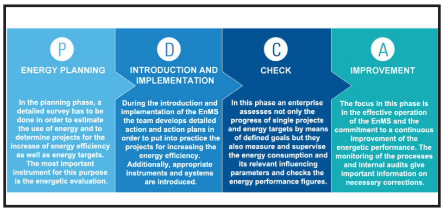


Fig. 6: Energy saving cycle ISO 50001

To determine the exact total leakage rate when analysing the initial situation (P), a mobile PI 500 flow meter with VA 500 volume flow sensor can be used, for example.

During a production standstill, the leakage or compressed air loss is measured and recorded.

With the CS Basic evaluation software, the leakage or compressed air consumption data can be analysed exactly.

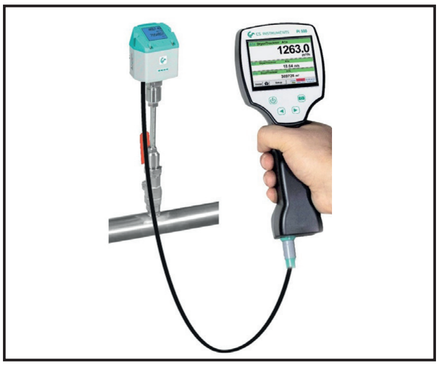


Fig. 7: Mobile flow meter PI 500 with volume flow sensor VA 500

Another measurement option is to measure the pressure decrease during a production stop over a defined period of time. For this purpose, however, the volume of the compressed air system must also be determined with great effort, which is almost impossible. Therefore, this method is often ruled out.

This type of measurement is obsolete and contains large measurement uncertainties, since the pressure drop and also the temperature must be measured very accurately.

A pressure decrease always results in a temperature decrease. In order to be able to recalculate to the standard volume, the absolute pressure must be measured accurately as well as the temperature (temperature at relaxation) at the pressure sensor.

If the total leakage rate is known, it can be used to calculate the annual savings potential in energy costs. For this purpose, the compressed air costs and the operating time of the compressor system are required in addition to the energy cost calculation.

Annual fixed costs of a compressed air system:

- Interest payments
- Amortisation
- Space usage costs

Variable costs of a compressed air system:

- Energy costs over full load and idle times,
- Auxiliary costs such as oil, cooling water, etc. p. a.,
- Maintenance and repair costs for compressors

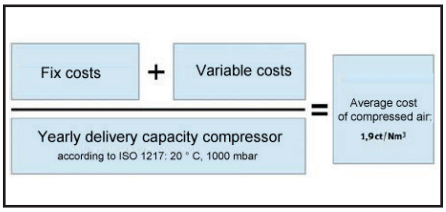


Fig. 8: Variable costs of a compressed air system

If the annual delivery capacity [m³] of the compressor system is now divided by the total costs [€], the costs per cubic metre of air produced are obtained.

The production of a standard cubic meter of compressed air costs, depending on the system, approximately 1.5 € cent/Nm³ to 2.7 € cent/Nm³.

Savings potential in energy costs [€ / year] =

Total leakage rate [Nm³/hour] * Compressed air costs [€/1 Nm³] * Operating hours [hours/1 year]

Since the escaping compressed air is not visible to the human eye, it is hardly possible to locate leaks in production plants without the appropriate equipment.

One solution to this problem is to locate leaks using ultrasound, since gases escaping through leaks correspond to an ultrasonic source. Ultrasonic transducers can therefore be used to locate leaks.

The frequencies of ultrasound that are inaudible to the human ear must be converted into an acoustic signal that is audible to the human ear.

This is done using a frequency mix that shifts the frequencies to a range that is audible to the human ear.

CS Instruments has developed the LD 500 as the successor to the LD 400 leakage detector.

With the leakage detector LD 500 it is not only possible to find the compressed air leakages, but also to calculate the amount of the escaping compressed air costs in l/min, to calculate and document the compressed air costs in €.

In addition, external sensors (gooseneck and parabolic mirror) have been developed to make it easier for the user to find leaks in different ambient conditions.

It is important for the user to know how much compressed air is leaking per leakage in order to be able to decide which compressed air leaks should be eliminated so that the repair costs do not exceed the leakage costs.

Table 1: If the various leakage rates are expressed in standard litres per minute as a function of the leakage diameter in mm and the pressure in bar.

p (rel.)	0,5 mm	1, 0 mm	1,5 mm	2,0 mm	2,5 mm	3,0 mm
3 bar	9 l/min	36 l/min	81 l/min	145 l/min	226 l/min	325 l/min
4 bar	11 l/min	45 l/min	102 l/min	181 l/min	282 l/min	407 l/min
5 bar	14 l/min	54 l/min	122 l/min	217 l/min	339 l/min	488 l/min
6 bar	16 l/min	63 l/min	142 l/min	253 l/min	395 l/min	569 l/min
7 bar	18 l/min	72 l/min	163 l/min	289 l/min	452 l/min	651 l/min
8 bar	20 l/min	81 l/min	183 l/min	325 l/min	508 l/min	732 l/min

Table 1: Leakage rates as a function of diameter and pressure

In Table 2, the costs caused by leakages are calculated over an operating year (365 days and 24 hours) at a price of 1.9 € cent/Nm³.

p (rel.)	0,5 mm	1,0 mm	1,5 mm	2,0 mm	2,5 mm	3,0 mm
3 bar	90 €	361 €	812 €	1.444 €	2.256 €	3.248 €
4 bar	113 €	451 €	1.015 €	1.805 €	2.820 €	4.061 €
5 bar	135 €	541 €	1.218 €	2.166 €	3.384 €	4.873 €
6 bar	158 €	632 €	1.421 €	2.527 €	3.948 €	5.685 €
7 bar	180 €	722 €	1.624 €	2.888 €	4.512 €	6.497 €
8 bar	203 €	812 €	1.827 €	3.248 €	5.076 €	7.309 €

Table 2: Costs caused by leaks

Due to the high costs, the LD 500 leakage detector pays for itself very quickly in the price range 2000 - 3000 €. The prerequisite is, of course, that the leaks found are repaired.

1.1 What is ultrasound? And how can the ultrasonic measurement be used for leakage measurement?

“In accordance with the definition of ultraviolet light, the word ‘ultrasound’ refers to the area of acoustic phenomena that is no longer accessible to human perception due to its high frequencies.

Fig. 9 shows the different frequency ranges of sound. Ultrasound not only involves the propagation of sound waves in gases or liquids, but also in solids. Since the upper limit of audible frequencies varies from person to person, there is no fixed limit between audible sound and ultrasound. Sound frequencies above 20 kHz are usually referred to as ultrasound.

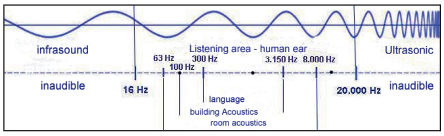


Fig. 9: Ultrasound as part of acoustics

Thre is no physical difference between auditory sound and ultrasound, since the laws of sound generation and propagation are frequency-independent. The reason for the distinction between the two sound forms lies in the different structure of the transducer, which generates or receives the sound.

1.2 Ultrasonic propagation

Sound waves are mechanical oscillations of the particles in a certain medium. This means that the particles that constitute the medium oscillate around their resting position.

Fig. 10 schematically shows the propagation of a damped wave to adjacent particles.

At time t0, the first particle is in its rest position, then it is excited. Between the particles lies the constant distance Δx. The duration until the excitation reaches the neighbouring particle corresponds to Δt.

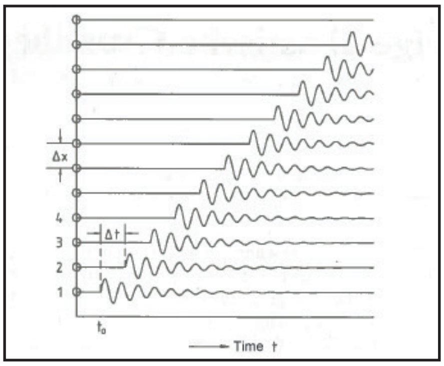


Fig. 10: Time/ space diagram of the propagation of a wave

The ratio from Δx / Δt corresponds to the speed of propagation. This depends on the medium in which the lossless wave propagates.

Depending on the excitation, ultrasound propagates in the form of (a) longitudinal or (b) transverse waves in liquids and gases.

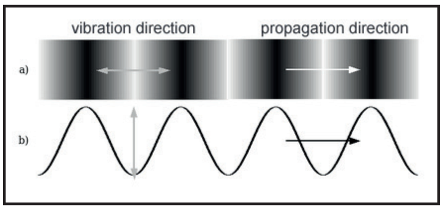


Fig. 11: Wave types in liquids and gases

1.3 Sound field sizes

A room in which sound waves propagate is called a sound field.

The sound pressure or sound alternating pressure is the number of over- and under pressures that occur when, for example, air molecules are moved from their rest position. This spatial shift leads to a rapid density (kg/m³) and pressure change (N/m²).

The **sound speed** (m/s) describes the speed at which the molecules oscillate around their rest position. It is defined as the sound deflexion per time unit.

The speed of {1} sound propagation in the medium of air is 343 m/s at 20 °C. In liquids and solids, sound propagates faster.

Fig. 12 schematically shows the sound pressure profile generated in the sound field of a flat ultrasonic transmitter.
Lines connect points of equal sound pressure, yellow/light grey tones indicate a high sound pressure, blue/dark grey tones a low sound pressure.

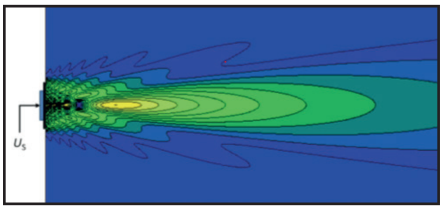


Fig. 12: Ultrasonic field of a spherical source

1.4 Reflection and refraction

If a plane sound wave hits a flat boundary surface in a gaseous or liquid medium, it is refracted and reflected depending on the material of the interface.

This is illustrated in Fig. 13. The incoming wave in medium 1 hits the boundary surface and is reflected back into medium 1 at the same angle (entry angle = exit angle).

Depending on the nature of the interface, the wave is additionally refracted and part of the energy is released into medium 2.

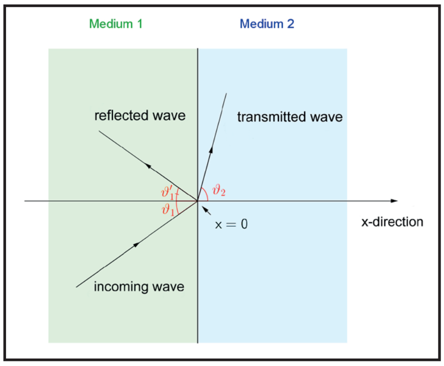


Fig. 13: Reflection and refraction of ultrasound

2. Measurement method of the leakage location spills are leaks in the compressed air network through which compressed air escapes unused and expands to ambient pressure. For compressed air consumption analysis, they are seen as an additional consumer that must be supplied by the compressor to provide the required system pressure.

Leaks usually occur where there are connections between different elements. Leaks are usually caused by improper installation or the use of damaged or worn components.

Possible causes of leaks:

- Leaking couplings and hose clamps
- Leaking screw and flange gaskets
- Porous/defective hoses
- Porous/defective seals of tools and machines
- Faulty steam trap
- Leaking or incorrectly installed dryer, filter and maintenance units
- and son on.

In the following chapter, the advantages and disadvantages of two methods for locating leaks are explained.

2.1 Leak Detection Spray

Leakage detection with a leak detection spray involves spraying the pressurised liquid onto the area to be checked.

If air bubbles form inside the liquid, air escapes and a leak has been found. This is illustrated in **Fig. 5.**

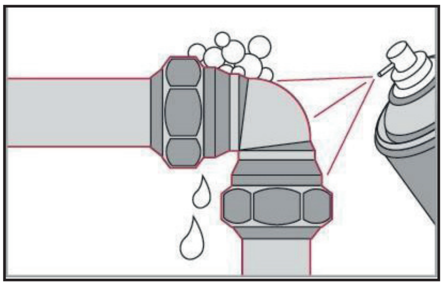


Fig. 14: Functionality of the Leak Detection Spray

Fig. 14 shows an example of a leak detection spray.

Advantages of the leak detection spray:

- With the leak detection spray it is possible to detect even the smallest leaks.
- The location is very precise because the air bubbles show exactly where the air escapes.
- The leak detection spray is very inexpensive. A can costs approx. 5 €.

Disadvantages of the leak detection spray:

Companies that have to comply with high hygienic standards may not be allowed to use a leak detection spray as it may contaminate the product produced.

- The Leak Detection Spray can be used to check selectively whether a leakage is present or not. It is not possible to quantify the leakages. In the case of a leakage with a high loss volume flow, the leak detection spray is more likely to be blown away than to form bubbles. These large leakages would therefore also be found if the pipes were run down with the palm of the hand.
- Checking all lines with the leak detection spray would be very time-consuming and sometimes associated with a very high expenditure, since the compressed air lines are often fastened to walls or ceilings.

2.2 Leak detection device LD 500 / LD 510 Ultrasonicl

If compressed air flows through a pipe, friction occurs on the inside of the compressed air line.

This friction depends on the roughness of the pipe surface. Friction also occurs when the pressurised air escapes through a leakage opening.

This friction generates an ultrasound, which can be received by an ultrasound transducer, when compressed air exits at a pressure of approx. 0.3 bar relative to the atmospheric pressure.

For this purpose, a leakage was generated and examined for the frequency components contained in the sound. The result of the spectral analysis shows that the transducer used has the highest sensitivity at 40 kHz.

In order to measure the leakage ultrasound, a 40 kHz transducer is used whose output voltage changes proportionally to the sound pressure.

Advantages of leakage detection using LD 500 ultrasound:

- The ultrasound, which is inaudible for humans, is evaluated by the LD 500 leakage detector.
- The leakage corresponds to an ultrasonic source, the exiting sound propagates in the room. This means that it is also possible to locate lines that are relatively far away.
- By comparing sound pressure levels, the transmission power of the source can be determined. Leaks through which a lot of air escapes produce a higher sound pressure level than leaks at which relatively little air escapes. This allows leakages to be compared in terms of their measured decibel value. This value is formed by the logarithmic ratio between the instantaneous RMS value of the sound pressure and the RMS value of the reference pressure. Defective steam traps
- Leaks can be quantified by the distance to the leak, system pressure and ultrasonic level.

Disadvantages of leakage detection using ultrasound:

- Ultrasound is not only generated by leaks. Ultrasound noise can therefore occur. Electric motors, for example, can emit ultrasound in a frequency range similar to that of leaks. However, the noise generated differs from the leakage noise. However, this can cause confusion for the user.

Possible remedy: Use of the parabolic mirror

By using a parabolic mirror, even the smallest leakages <0.8 l/min (approx. 8 € p.a.) can be localised precisely (+- 15 cm) at a distance of up to 10..15 m. This ensures that only ultrasonic waves of the targeted compressed air leakage are evaluated. The user can find even the smallest leaks.

- Compressed air is regularly blown off pneumatic cylinders. This of course also generates an ultrasound and can irritate the user.

Possible remedy: Leak detection during production stop

If pneumatic, cylinders, valves etc. periodically blow off pressure themselves, ultrasound is also generated, thus making leak detection more difficult. A possible remedy here is to leave the compressed air system under pressure, but to switch off all functions that lead to a blow-off.

- The reflection of ultrasound on walls can disconcert the user. The user hears the acoustic noise of a leakage, although there are no pipes running at this location and therefore no air can escape.

Possible remedy: Leakage insulation

Here the user can block the outgoing air with the help of a plate or foil.

Compressed air leaks generate a strong ultrasonic field, which can possibly generate an ultrasonic signal in the entire room.

Here again it is recommended to reduce the sensitivity (jump to manual level). If the attenuation is not sufficient, the leaks can still be detected via the difference in volume.

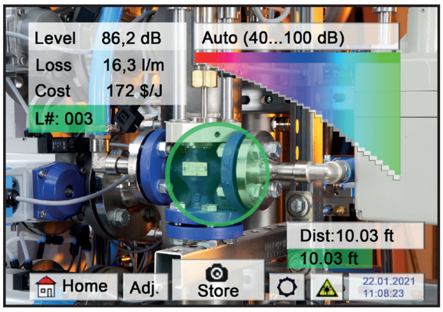
2.3 Finding compressed air leaks, measuring the leakage rate with the leakage detector LD 500 / LD 510

The LD 500 ultrasonic units are highly recommended for regular checking of the compressed air system for leaks, as they can be used anywhere and the time required for locating is limited.

Until now, leakage detectors have only been used to locate leaks. It was difficult to quantify the leakage rate in litres/min. With the new LD 500 leakage detector, the user can see the leakage rate in litres/min (or cfm for US units) directly on the display.

In addition, the device calculates the resulting leakage costs in Euro per year (freely selectable currency) and also shows this on the display. This enables the user to decide on site which leaks can be remedied as quickly as possible due to the high losses and which ones are more likely to be remedied in the medium term.

The integrated camera shows the photo of the found leak directly on the screen of the LD 500. For documentation purposes, the photo, the leakage rate in litres / min, the costs in euros, name of the company, department, measuring location with date and time are stored in the LD 500.



The stored data can be exported to any commercially available USB stick and evaluated with the optionally available PC evaluation software “CS Leak Reporter”.

The software automatically generates a clear report on all leaks found in the company with photo, litres / min, costs and all other details. The report can be created for the entire company or per department and saved as a pdf file.

The totals at the end of the report provide a simple overview of the total leakage quantity in litres/min as well as the leakage costs per year.

The LD 500 Leakage Detector is offered as a complete set in a robust service case. The set includes useful accessories such as a shotgun with a straightening tip for precise location of leaks in confined spaces and a bell for locating even the smallest leaks up to 6 m away.

For special requirements such as leak detection at a distance of up to 20 metres, a parabolic mirror is available as an optional accessory, and a flexible gooseneck is available for extremely hard-to-reach areas.

The best results are achieved with LD 500 leak detection when production is stopped and the compressed air network is kept under pressure. If this is not possible, it is still possible to reduce the

The use of the gooseneck, which due to its reduced sensitivity finds leaks precisely, is recommended.

The gooseneck is ideally suited for these conditions as it locates leaks at short distances and is therefore less affected by ambient noise.

The LD 500 / LD 510 uses special noise-damping headphones for use during production.

Further applications of the LD 500 / LD 510 leak detector

- Detect bearing wear and lubricant deficiency
- Leak test of condensate separators and valves
- Detection of partial discharges
- Leak test
- Vacuum leakages
- Steam leakages

2.4 Advantages in practice when using the LD 500 / LD 510 leak detector

Automatic and manual sensitivity adjustment

With a very high sensitivity, which can be adjusted automatically or manually, it is possible to locate both very large and very small leaks and measure their sound pressures.

Sensitivity adjustment is advantageous if one or more large ultrasonic sources are close to each other or if there are ultrasonic noise interferences.

The automatic sensitivity control enables the user to find and measure very small leaks < 0.1 l/min at a maximum distance of up to 20 m and also very large leaks of approx. 100 l/min.

The automatic sensitivity control automatically switches to the optimum sensitivity range for each size of leakage.

Location of leakage Calculation of leakage rate in l/min and calculation of costs in € with LD 500

With the previous leakage detection devices it is only possible to locate leaks. Until now, it was not possible to specify the leakage rate in l/min or to calculate the leakage costs.

With the LD 500 it is now possible to locate both, even the smallest compressed air leaks < 0.1 l/min at a distance of more than 20 m and to calculate the cost of the compressed air leakage in €.

With the LD 500 it is now possible to locate both, even the smallest compressed air leaks < 0.1 l/min at a distance of more than 20 m and to calculate the cost of the compressed air leakage in €.

On the basis of the calculated costs of the leakage it is decided which leaks should be repaired and which not. Since the repair of leaks is associated with costs, the calculation of the leakage costs must be as precise as possible. If the actual leakage costs caused are lower than the repair costs, the user makes an efficient loss.

A further advantage of the LD 500 compared to other commercially available leakage detectors is the leakage measurement with different attachments from 5 cm to approx. 20 m. The LD 500 can be used as a leakage detector with a diameter of 5 cm.

Useful accessories for leakage measurement for LD 500 / LD510

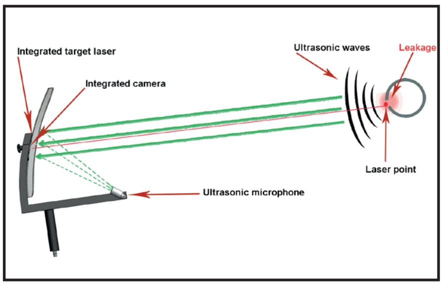
A further important point for locating and calculating the leakage is the accessory for the leak detector LD 500, which makes the user's work easier.

2.4.1 Acoustic trumpet

The acoustic trumpet bundles the sound waves of small compressed air leaks and thereby amplifies the audible signal. At the same time, it prevents lateral sound waves from hitting the ultrasonic transducer, making it easier for the user to locate the leakage.

The use of the acoustic trumpet is ideal for medium distances to the leaks (20 cm to 5 m), if a leakage is "heard", the user should approach it and locate it precisely. If this is not possible, it is recommended to use the gooseneck, which finds leaks precisely due to its reduced sensitivity.

2.4.2 Parabolic mirrors



LD 500 with parabolic mirror

Since ultrasound is reflected at interfaces, it is possible to use this feature to bundle the ultrasound at the focal point over a larger parabolic surface. This leads to a higher gain and thus to a higher range of the LD 500.

By bundling the ultrasonic waves in the parabolic mirror, even the smallest leaks <0.8 l/min (approx. 8 € p.a.) can be localized at a distance of up to 10..15 m with pinpoint accuracy (+-15 cm). The shape of the parabolic mirror ensures that only ultrasonic waves of the targeted compressed air leakage are evaluated.

This allows the user to measure even the smallest leaks, e.g. on compressed air lines in production halls under the ceiling, at great heights and locate them precisely.

The LD 500 is currently unique on the market due to its precise location and measurement of leakage with laser pointer and camera in a parabolic mirror.

2.4.3 Gooseneck

- **LD 500 with gooseneck**

The gooseneck enables the accurate location of compressed air leaks at hard-to-reach points, e.g. in machines and systems.

Since some compressed air lines are difficult to access, a flexible gooseneck can be used. This serves as an extension of the arm for leaks that are far away and difficult to access.

The sensitivity of the gooseneck is lower than that of the funnel and the parabolic mirror, since it is measured closer to the leaks.

Due to this reduced sensitivity, less ambient noise is amplified and thus perceived, which is a huge advantage of the gooseneck. It is therefore the right attachment for heavy duty applications.

The length of the gooseneck is 0.6 m and 1.5 m respectively.

2.4.3 Straightening tube with straightening tip

The straightening tube enables the precise location of compressed air leaks from several tiny leaks in a very small space, e.g. in a compressed air distribution cabinet with valve terminals and a large number of compressed air hoses.

2.5 Documentation, evaluation, report generation from a single source with the LD 500

With the LD 500, all relevant data for each leakage can be entered and stored. The CS Leak Reporter software is available for the evaluation, documentation and reporting of the leakage. The relevant leakage data are stored in the LD 500:

- Picture of the leakage
- Date and time
- Company name/department/machine etc.
- Larg leakage in litres / minute
- Cost of leakage per year in €.
- Leak Day No.

In addition to the data stored in the LD 500, the leak tags with all leakage data may remain in paper form on site for documentation purposes.

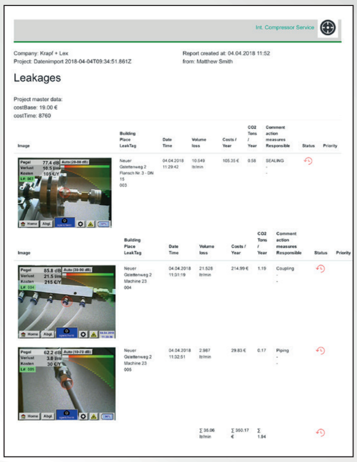
This helps the maintenance technician to easily find the compressed air leakage and decide on site which leaks need to be eliminated immediately.

CS Leak Reporter

Leakage data stored in the LD 500/510 is exported to a USB stick for reporting via software.

If the leakage is found and stored, the following data are also stored in the LD 500 / 510 and are available again for creating the report after exporting it in the CS Leak Reporter software.

Leakage Report for ISO 50001 Audits

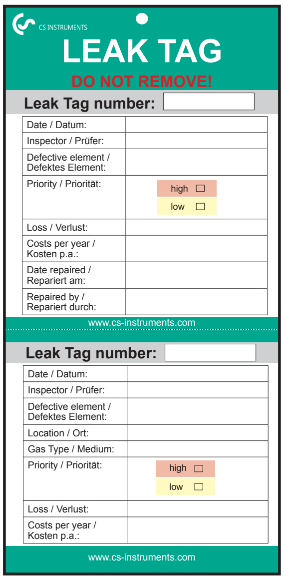

Leakages

- Picture of the leakage point
- Date and time
- Company name/department/machine
- Size of the leakage in litres/min (unit adjustable)
- Cost of leakage per year in € (currency adjustable)

PC software CS Leak Reporter can be used to create detailed reports that can be made available to the compressed air system operator or department manager.

The report can be created for the entire company or per department to document all leaks easily and clearly.

The totals at the end of the report provide a simple overview of the total leakage management in litres/min and the total leakage costs per year.


CS INSTRUMENTS

LEAK TAG

DO NOT REMOVE!

Leak Tag number:

Date / Datum:	
Inspector / Prüfer:	
Defective element / Defektes Element:	
Priority / Priorität:	high ☐ low ☐
Loss / Verlust:	
Costs per year / Kosten p.a.:	
Date repaired / Repariert am:	
Repaired by / Repariert durch:	

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Leak Tag number:

Date / Datum:	
Inspector / Prüfer:	
Defective element / Defektes Element:	
Location / Ort:	
Gas Type / Medium:	
Priority / Priorität:	high ☐ low ☐
Loss / Verlust:	
Costs per year / Kosten p.a.:	

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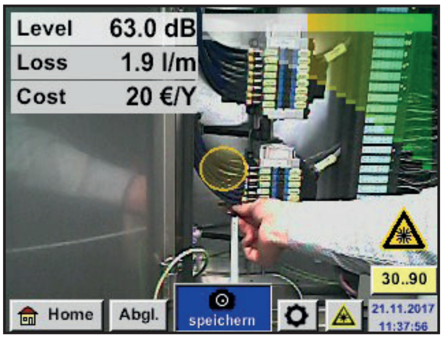
Fig. 15: Leak tag for documentation of a leakage

2.6 Measurements in Practice with the LD 500 in Compressed Air Control Cabinet

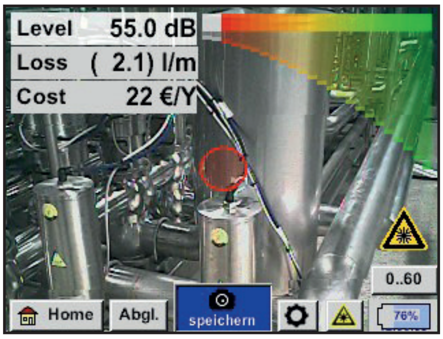
The problem with these is that the hoses are very tightly spaced and the ultrasound is reflected by the cabinet wall.

Here the straightening tube with the straightening tip or the gooseneck must be used to find the exact location of the leakage as the compressed air leakage is very small.



Leaking plug connection

Typical leakage with connectors can be found very quickly and easily by means of funnels or parabolic mirrors at greater distances (3-10 m), even if the loss value is very low.



Leaking plug connection