JWFROEHLICH

Test and Assembly
Solutions for Powertrain

Leak Test Handbook

Measuring, Testing, Practical Use

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Leak tightness testing
Basic principles

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The test part

Tight or leaking?

Leak tightness is a relative term. The requirement for a component to be leak tight always relates to the conditions at the location where it is to be used. The leak test method, the level of pressurisation and the allowable leak rate must be established in accordance with these conditions during the manufacture of a component.
This is where the first doubts may arise. Allowable leak rate? The test parts need to be tight! Individual parts in internal combustion engines, for example, must be watertight or oiltight; others must not allow any fuel or gas leakage.
As a general rule, the leak test should be carried out on a component at the earliest possible stage within a manufacturing process. This should provide an indication of whether the component will be tight under the subsequent operating conditions.

Functional leak tightness

In a dunk test, air leaks out of the test part and the bubbles formed rise once they reach a diameter of 1 mm. If this occurs every 30 seconds, a leak rate of 0.001 cm³/min can be calculated. Assuming that this test part is a passenger car tyre (interior volume approx. 40 l), such a leak would cause the tyre pressure to fall by 0.1 bar within 10 years.
If this bubble rises every 3 seconds, the corresponding leak rate is 0.01 cm³/min. The above-mentioned pressure decay in the tyre will then occur within one year.

Should this tyre be categorised as tight or leaking?

Should the car tyre now be considered tight or leaking?
The allowable leak rate of Freon from refrigerator compressors, for example, is 1 g/year at a pressure of 10 bar.
That corresponds to a leak rate of 3.8×10^{-4} std cm³/min.

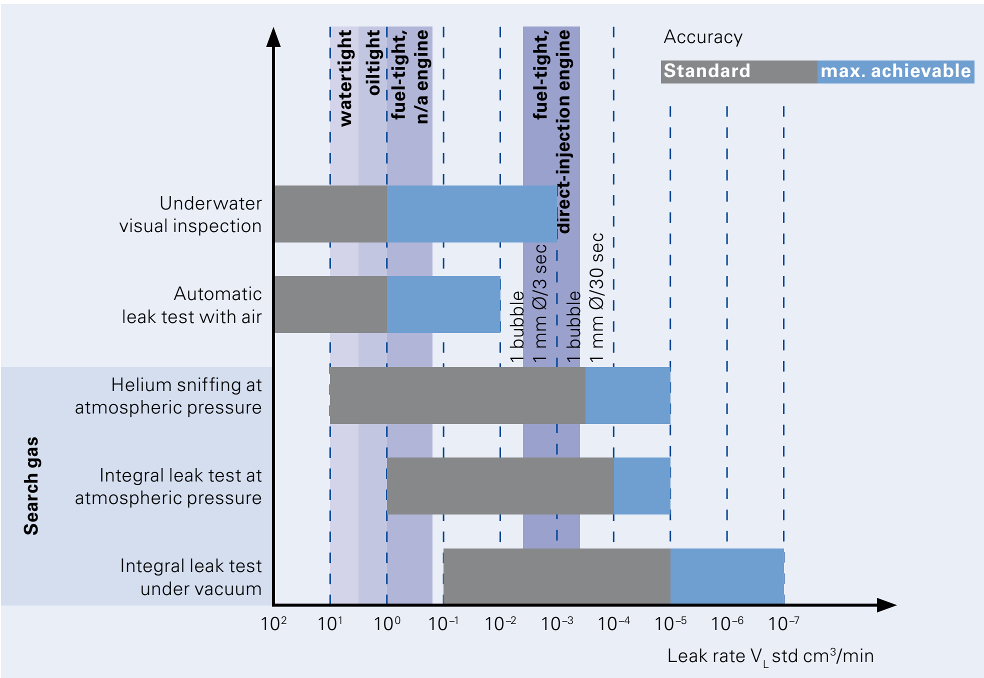
The question of "tight or leaking" therefore comes down to the definition of the allowable leak rate V_L all.
Test parts are categorised as follows: leak rate < V_L = tight and leak rate > V_L = leaking

Leak rate < V_L = tight
Leak rate > V_L = leaking

Test accuracy

Underwater visual inspection is a relatively accurate leak test method – provided it is carried out with due care and attention and the test part can be clearly observed throughout. If the leak rates which can be obtained in this way are to be detected by automatic leak test equipment, it is necessary to use highly sensitive search gas procedures, e.g. with helium. However, underwater visual inspection is preferred

Common leak test methods in series production



not only due to its accuracy but also as it is relatively inexpensive and – an extremely important advantage – enables the leak to be pinpointed instantaneously.
The disadvantages of this leak test method: it is dependent on the operator (low reliability), it is time-consuming and the test parts become wet. These are the reasons in favour of using automatic leak test equipment.

The criterion for the precision of the leak test panel is the reproducibility of the test results. This is calculated from 50 measurements using a tight master part. Reference values for the ratio of the leak rate V_L to the standard deviation

Repeat accuracy

in laboratory conditions
(i.e. not influenced by the leak test machine = firmly sealed master part)

$$\frac{V_L}{s} \geq 20$$

in production conditions

$$\frac{V_L}{s} \leq 7$$

$$\frac{V_L}{s} \geq 20$$

$$\frac{V_L}{s} \leq 7$$

The level of accuracy which can be achieved with the test part under production conditions as well as the shortest possible test time can only be determined through experimentation. These factors are primarily dependent on the size of the test volume and the test specification, as well as on the condition of the sealing device and of the test part.

Testing with air is now widely used for the automatic leak testing of series parts as it offers the following advantages:

- Highly reliable operation and results
- Objective and quantified assessment of quality
- Short test times
- Low investment and running costs
- Sufficient accuracy
- Gentle treatment of test parts
- Simple integration into interlinked production processes
- Simple calibration

Automatic leak testing has recently gained further importance in connection with the requirements arising from the following areas:

- ISO 9000
- Product liability
- Duty of documentation
- Environmental protection
- Consumer protection
- Workplace design

Test specifications

Leak testing involves four crucial pieces of information: test pressure, allowable leak rate, test volume and test time.

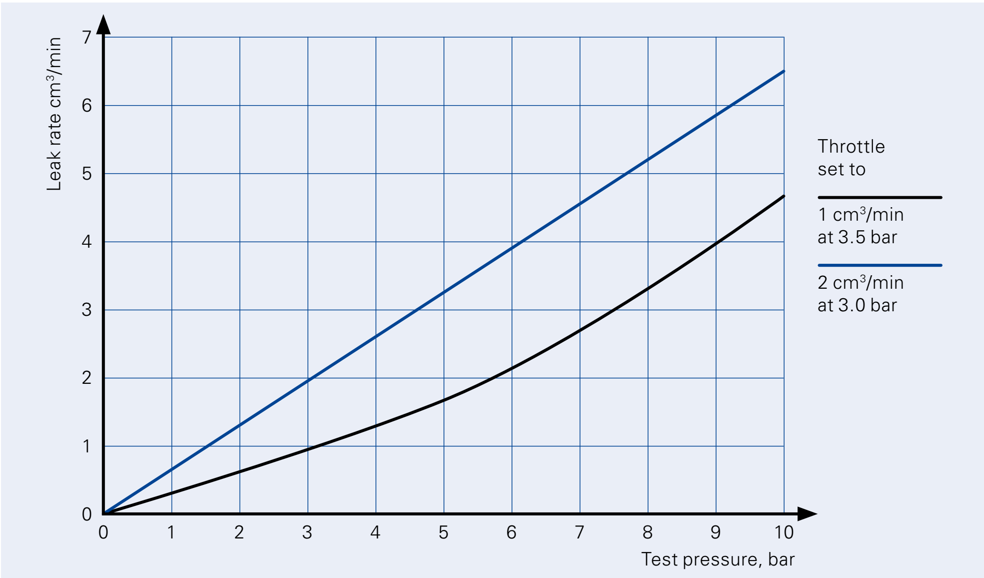
Allowable leak rate

The key question is: what is the maximum allowable air leak rate that can still guarantee that no fluid will escape from a test part under operating conditions?

When considering this question, it must be borne in mind that the allowable leak rate is different for each specific application. It depends on a range of factors, e.g. the material of the test part, its structural characteristics and the loads it will be subject to under operating conditions.

The ratio of the air leak rate to the fluid leak rate corresponds roughly to the ratio of the respective viscosities. However, other factors such as the wall thickness of the test part, the type of material and the structure of the leak (shrink holes, fissures, faulty seals, etc.) also play an important role.

Leak rate as a function of test pressure



A leak rate value always relates to a particular test pressure. The pressurisation of the test part during leak testing is generally selected so that it simulates the subsequent operating conditions, in terms of both the level of the test pressure and the test direction (overpressure or vacuum).
Determining the test pressure involves establishing the relationship between test pressure and leak rate. With large leaks, the leak rate is approximately proportional to the test pressure; with small leaks, the ratio of the leak rate to the test pressureis smaller.

Small leaks are not constant. The influence of moisture can cause them to vary, for example. If the result of an automatic dry test is to be checked via underwater visual inspection, this influence must be taken into account. Economic considerations also play a decisive role when determining the allowable leak rate.

The test should be only as accurate as necessary and not as accurate as possible. If the allowable leak rate is set lower than necessary, the number of rejects and consequently the costs will increase.

Examples of allowable leak rates for car engine parts

		Test pressure [bar]	Allowable leak rate [std cm³/min]
Cylinder block			
Cast iron	Water jacket	1.0 – 1.5	10 – 12
	Hydraulic oil ducts	2.0 – 3.0	5 – 6
Aluminium	Water jacket	1.0 – 1.5	4 – 12
	Hydraulic oil ducts	2.0 – 3.0	3 – 6
Intake manifold	Intake ports	1.0 – 1.5	30 – 50
	Water jacket	1.0 – 1.5	4 – 12
Water pump		1.0 – 1.5	approx. 8
Fuel rail		4.0 – 5.0	1 – 2

60 std cm³/min = 1 mbar l/sec

The final leak rate allowed for production operation must be empirically determined. In many cases, previously established values can be drawn on or recommendations can be given. For leak test methods using air as the test medium (pressure or mass flow measurement), the leak rate is usually given in std cm³/min; for leak tests using a search gas (e.g. helium) it is generally given in mbar l/sec: 60 std cm³/min = 1 mbar l/sec

At this juncture it should be noted that 1 std cm³ is a quantity of gas which occupies 1 cm³ in normal physical conditions (0°C and 1013 mbar).
1 std cm³ is therefore not a measurement of volume but a quantity of gas expressed in terms of volume. The unit std cm³/min describes a mass flow. This means that if the leak rate is given in std cm³/min then, strictly speaking, either the mass flow measurement method must be used or the pressure measuring signal must be corrected for the influence of barometric pressure and the ambient temperature. If neither of these steps is taken, the correct unit for the leak rate is cm³/min or ml/min. The difference between normal conditions and test conditions is on average around 10%.

Formulae and calculations

Test volume

$$V_T = \frac{P_{ATM} \times V_L \times t_m}{\Delta p \times 60}$$

Leak rate

$$V_L = \frac{\Delta p \times 60 \times V_T}{P_{ATM} \times t_m}$$

Measuring time

$$t_m = \frac{\Delta p \times V_T \times 60}{P_{ATM} \times V_L}$$

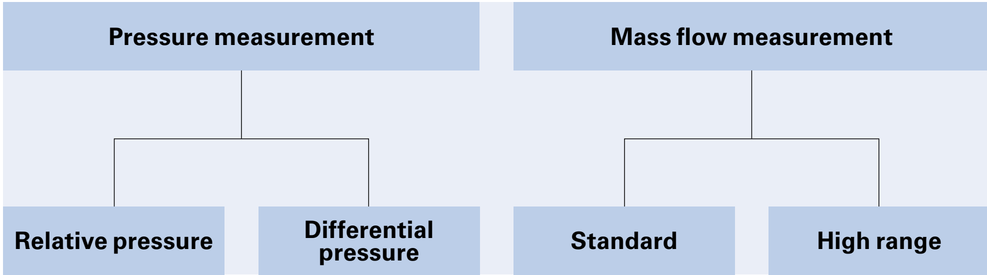
V_T = test volume in cm^3 (volume of test part incl. measuring system, connecting lines and sealing device)
V_L = leak rate in std cm^3/min.
P_{ATM} = atmospheric pressure in (100,000) Pa
t_m = measuring time in seconds
Δp = pressure decay displayed, in Pa

Technical leak tightness*

ø hole	Leak rate in mbar × l/s	General description of leak ($\Delta p = 10^5$ Pa)	Description of gas leak ($\Delta p = 10^5$ Pa) ≈ 1 cm^3 gas lost per
≈ 1 mm	10^2	water leaking out	
≈ 100 µm	10^0	dripping tap	second
≈ 10 µm	10^{-2}	watertight (does not drip)	100 seconds
≈ 3 µm	10^{-3}	vapour-tight (sweating)	15 minutes
≈ 1 µm	10^{-4}	bacteria-tight	3 hours
≈ 300 nm	10^{-5}	petrol-tight and oiltight	day
≈ 100 nm	10^{-6}	virus-tight	10 days
≈ 30 nm	10^{-7}	gas tight	100 days
≈ 10 nm	10^{-8}	virus-tight (secured)	3 years
≈ 3 nm	10^{-9}	gas tight (secured)	30 years
≈ 1 nm	10^{-10}	completely tight (technically tight)	300 years

* The allowable leak rates used in the practical applications are higher in some cases based on previous experience.
The hole diameters are rough estimates.

Measuring procedures



In automatic air leak testing, the test part is exposed to a pressure difference, making it possible to detect whether air is escaping. The quantity of air escaping cannot be directly measured – only its effect.
There are two fundamentally different measuring procedures: pressure measurement and mass flow measurement.
Pressure measurement involves applying a test pressure to the test part and separating the part from the pressurised air source. The subsequent measuring phase consists in checking whether the test pressure has changed as a result of leakage.
Mass flow measurement also involves applying a test pressure to the test part, but the part remains connected to the pressurised air source. The measuring phase consists in checking whether air is entering the test part as a result of leakage.

Pressure measurement

Pressure measurement is the procedure most commonly used in industrial leak testing. At low test volumes it is possible to detect leaks as small as 0.1 cm³/min.

Relative pressure

The relative pressure or absolute pressure method allows the use of a measuring system with a compact design and minimal volume. It also offers high levels of operational reliability and a large measuring range. The measuring signal resolution is dependent on the level of the test pressure.

Differential pressure

The differential pressure method can enable greater accuracy at higher test pressures than the relative pressure method, as the measuring signal resolution is independent of the level of the test pressure.

Pressure decay

A pressure decay test, in which overpressure is applied to the test part, simulates standard operating conditions.

Pressure rise

In a pressure rise test using the vacuum leak test method (with a bell jar), the interference resulting from temperature changes or instability in the volume of the sealing device or test part is smaller than in a pressure decay test. In a pressure rise test using the overpressure method (capsule method), the level of the test pressure is not limited by the measuring range of the measuring element, as this is not exposed to the test pressure.

Mass flow measurement

With pressure measurement, the measuring signal becomes smaller as the test volume becomes greater; mass flow measurement, on the other hand, gives a measuring signal that is independent of the size of the test volume.
In a mass flow test (thermal measuring procedure), the measuring signal is independent not just of the size of the test volume but also of the atmospheric pressure and atmospheric temperature. Here, there is a direct correlation between the measuring signal and the leak rate in std cm³/min: The leak rate does not need to be calculated as it does for pressure measurement tests.
The high-range mass flow method is used for applications with relatively high allowable leak rates (> 500 cm³/min). The test pressure is held constant by the built-in pressure regulator even in the event of significant leakage.

Measuring phases

The complete automatic leak test process consists of at least four phases:
1. Filling, 2. Balancing, 3. Measuring, 4. Venting

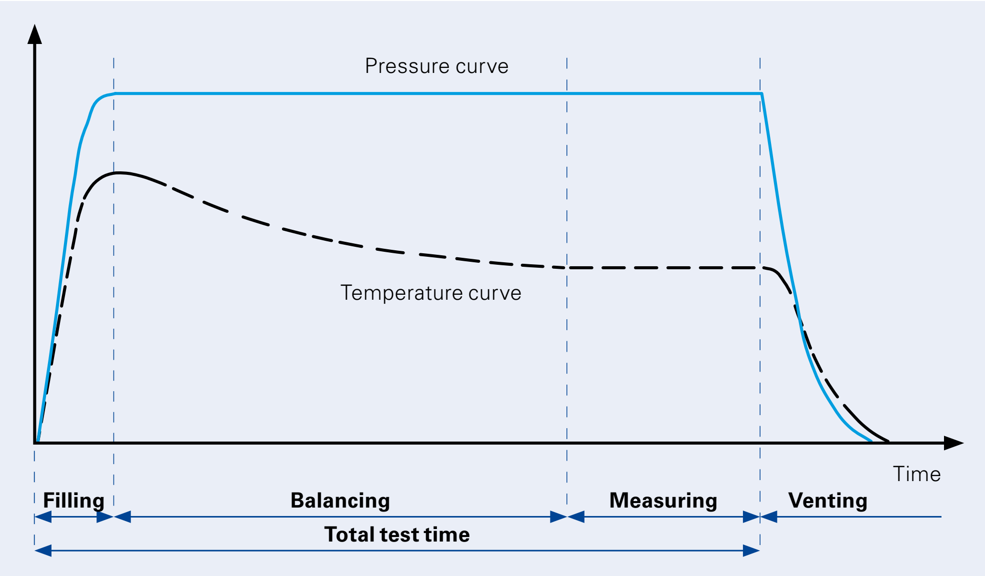
Filling phase

The test part is pressurised.

Balancing phase

During this period, the test system must reach a stable state. The turbulence generated during the filling process should settle down, and the resultant changes in the temperature of the test air must balance out – the air flowing into the test part expands at the filling valve and cools down, while the air inside the test part becomes compressed and as a result heats up. The latter effect predominates, as shown by the profile of the temperature variation in the water jacket of a cylinder block during the four phases of the leak test.

Temperature and pressure of test air over time



As the temperature changes, the pressure in the test volume changes accordingly. If the leak test panel is to display "zero" for a tight part, an isothermal state must first be reached. However, the time required to reach this "perfect balance" is significantly longer than customary cycle times in industrial volume production. The balancing phase can be shortened as follows:

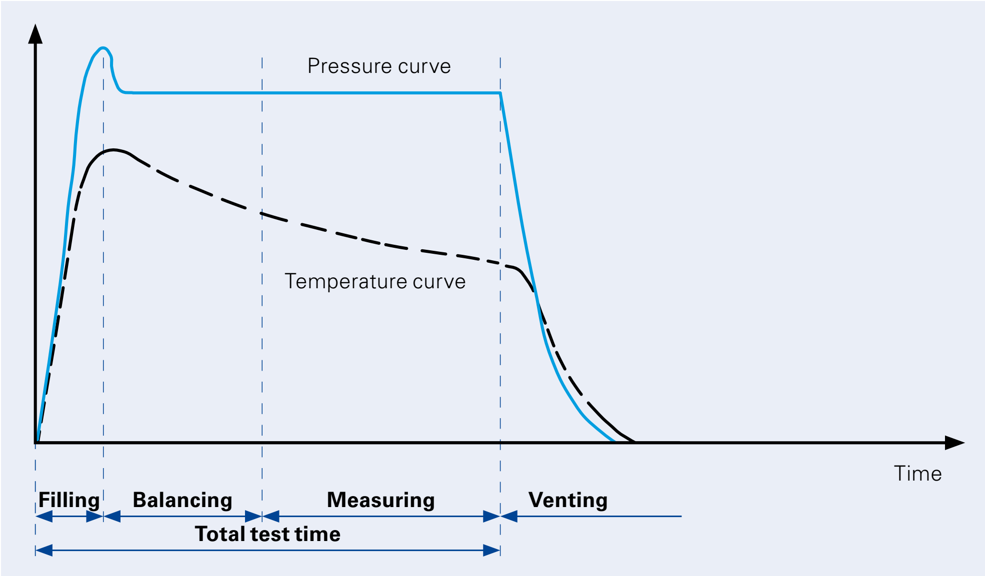
Compensation filling (shock filling)

Compensation filling involves applying a filling pressure which is somewhat higher than the test pressure to the test part during an additional pre-filling phase. During the transition from the pre-filling phase to the filling phase, the filling pressure is reduced to the test pressure. The air in the test volume cools down in the course of this expansion process, which compensates for the "imperfect balance". By varying the filling pressure, it is possible to achieve a reading of "zero" for a tight part even after a short balancing phase. This "shock filling effect" also reduces the filling time. The effect is dependent on the material of the test part and its thermal conductivity.

Advancing the start of the measuring time ("optimised balancing") Offset

As a reading of "zero" for a tight part is not the goal of leak testing, the balancing time can be easily reduced by advancing the start of the measuring phase.

Reducing the balancing time by advancing the measuring phase



The balancing time can be reduced until the state in the test system before the beginning of the measuring phase is no longer sufficiently reproducible. In "optimised balancing", the value X is displayed for a tight test part at the end of the measuring phase. The reject limit must be offset by this value. The above-mentioned methods are frequently combined in practice.

Measuring phase

$$\frac{p \times V}{T} = \text{constant}$$

$$p \times V = \text{constant}$$

$$p_1 \times V_T = p_2 \times V_T + p_{At} \times V_L$$

$$\Delta p = p_1 - p_2$$

$$\Delta p \times V_T = p_{At} \times V_L$$
or
$$\Delta p = p_{At} \times \frac{V_L}{V_T}$$

$$t_M = \frac{\Delta P \times V_T \times 60}{p_{At} \times V_L}$$

p_1 = pressure in test volume at start of the measuring phase
p_2 = pressure in test volume at end of the measuring phase
V_T = test volume in cm³
p_{At} = atmospheric pressure (1 bar = 10^5 Pa)
V_L = leak rate in cm³/min
t_M = duration of the measuring phase in s
Δp = pressure decay in Pa in the measuring phase

Escaping air generates a pressure decay in the test volume. This decay is measured and displayed. It is either measured as a deviation from a tight reference chamber using a differential pressure sensor, or the relative pressure change is detected using a pressure sensor.
While the duration of the filling and balancing phases must be empirically established, the measuring time can be calculated based on the gas law:
$$\frac{p \times V}{T} = \text{constant}$$
This presupposes an isothermal measuring process.
The equation is: $p \times V = \text{constant}$
When applied to the conditions in a leak tightness test using the pressure decay measuring method, this equation is: $P_1 \times V_T = p_2 \times V_T + p_{At} \times V_L$
The pressure change Δp during the measuring phase is calculated as follows:
$\Delta p = p_1 - p_2$
For $p_2 = p_1 - \Delta p$, the equation for the measuring process is:
$\Delta p \times VT = p_{At} \times V_L$ or $\Delta p = p_{At} \times \frac{V_L}{V_T}$

It is interesting to note that this equation does not include the level of the test pressure. The test pressure has no effect on the magnitude of the pressure change in the test chamber.
In other words: The magnitude of the pressure decay in a test part is always the same for the same leak rate, whether the pressure in the test part is 1 bar or 10 bar. However, the leak rate via a porous area becomes greater as more pressure is applied.
For a given test specification, the duration of the measuring phase can be calculated as follows: $t_M = \frac{\Delta P \times V_T \times 60}{p_{At} \times V_L}$

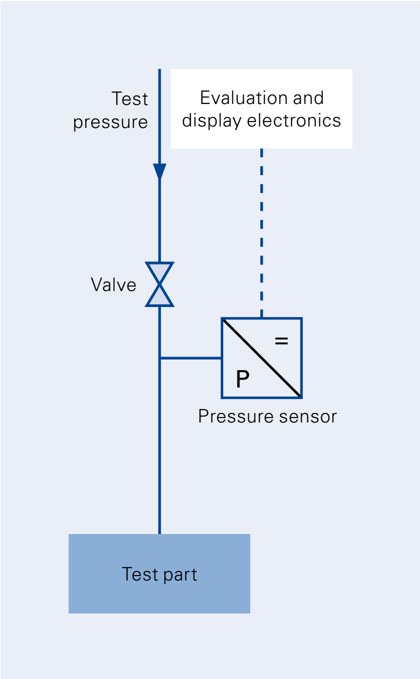
Measuring procedures
Definition, comparison, influencing factors

13 **Standard measuring procedures**
16 **Pressure vs. mass flow measurement for high-volume parts**
18 **Special measuring procedures**
20 **Influencing factors**

Standard measuring procedures
Overview and JW Froehlich solutions

Pressure measurement		Mass flow measurement	
Relative pressure	Differential pressure	Standard	High range
MPS100	MPS150		
MPS200	MPS250	MFL200	MFL260
MPS300	MPS350	MFL300	MFL360
MPS400	MPS450	MFL400	MFL460
MPS500	MPS550	MFL500	MFL560

Pressure measurement

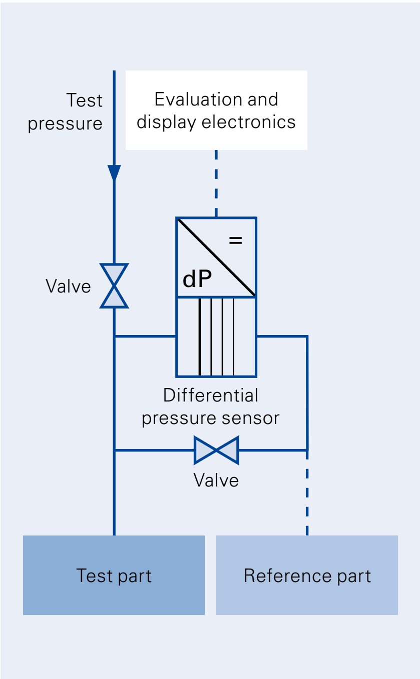


Relative pressure (standard pressure decay)

In the relative pressure method, the test part is pressurised with air and the pressure sensor is used to detect any leakage following the balancing phase. As the pressure sensor is only pressurised on one side, the test pressure which can be applied is limited. The relative pressure method is used for smaller test volumes and when sufficient test time is available, and is favoured for its cost effectiveness.

Features
Compact design
Minimal volume
Large measuring range

JW Froehlich leak test panels
MPS100
MPS200
MPS300
MPS400
MPS500



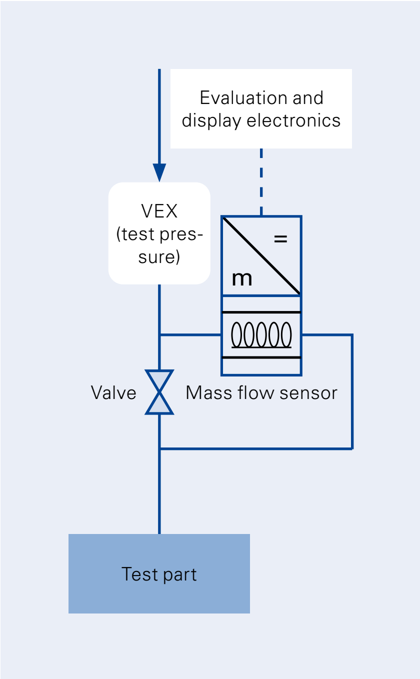
Differential pressure (high-resolution pressure decay)

In the differential pressure method, the test part is pressurised with air and the differential pressure sensor is used to detect any leakage following the balancing phase. As this sensor is pressurised on two sides, high test pressures of up to 20 bar can be achieved, delivering very fine measurement resolutions. The differential pressure method is thus preferred for high pressures and low allowable leak rates.

Features
High test pressures up to 20 bar
High measurement resolution independent of test pressure
Can detect small leak rates at high test pressures

JW Froehlich leak test panels
MPS 150
MPS 250
MPS 350
MPS 450
MPS 550

Mass flow measurement



Standard

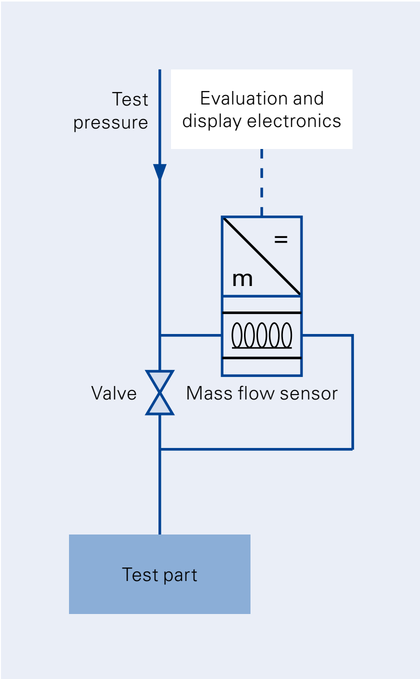
The first step of the mass flow method is to fill a reference volume VEX with test air. This is then used to fill the test part and achieve the test pressure. Unlike the pressure decay method, the mass flow sensor delivers immediate measurement results in the event of a leakage, which makes it the most suitable method for high-volume parts and short cycle times.

Features

- Measuring technology for large test volumes from 500 ml
- Instantaneous measuring signals thanks to mass flow sensor
- Shorter test times compared to pressure decay method
- Highly reproducible measurement results

JW Froehlich leak test panels

- MFL 200
- MFL 300
- MFL 400
- MFL 500



High range

The high-range measuring method is used when high allowable leak rates (> 500 cm^3/min) are required. The measuring circuit is designed in such a way that large air flows can be detected as mass flows at a constant test pressure.

Features

- Measuring technology for high leak rates
- Measuring signal independent of test volume and test pressure
- Measuring signal corresponds to leak rate in normal conditions
- Exceptionally reproducible measurement results

JW Froehlich leak test panels

- MFL 260
- MFL 360
- MFL 460
- MFL 560

Pressure vs. mass flow measurement for high-volume parts

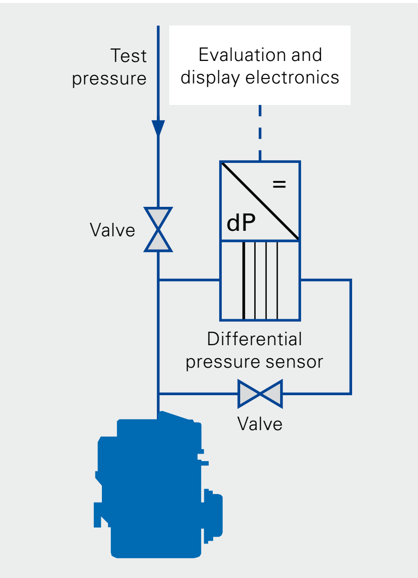
The test times available in fully automated test stations are generally very limited. As stated above, the mass flow method can offer advantages in terms of time, especially for high-volume test parts, in comparison with the pressure decay method. In addition, the level of reproducibility of the measurement results for measurement system analysis (MSA) is significantly higher.

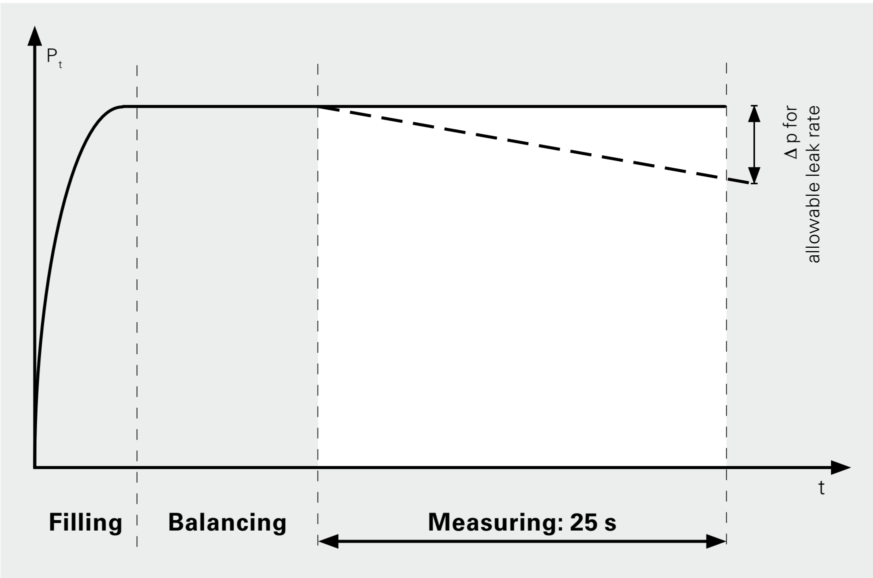
This is clearly demonstrated by the example of the oil chamber of an internal combustion engine as the volume to be tested, measuring 25 l. But the mass flow method also proves the faster solution for significantly smaller test volumes (from approx. 1 l).

Features

25 l oil chamber
0.3 bar test pressure
30 cm³/min. Allowable leak rate

Conventional measuring method: Pressure decay test using the differential pressure measuring method





Duration of the measuring phase for leak test on an oil chamber (typical test volume: 25 l)

t_m = measuring phase
AP = reject point (here 50 Pa)
V_T = test volume
P_{ATM} = atmospheric pressure
V_L = leak rate

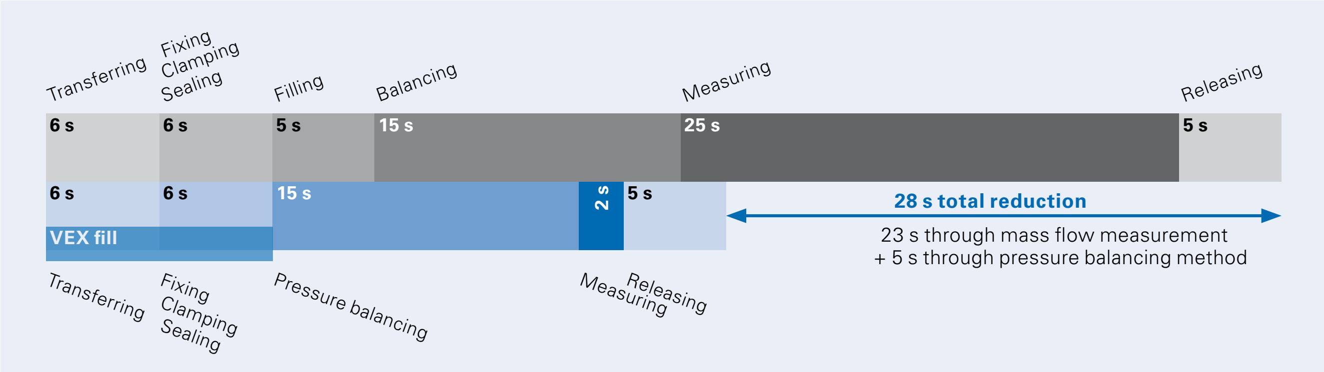
The measuring phase is dependent on the test volume and the leak rate. It is calculated using the following formula:

$$t_m = \frac{AP \times V_T \times 60}{P_{ATM} \times V_L} = \frac{50 \times 25 \times 10^3 \times 60}{10^5 \times 30} = 25\ \text{s}$$

Cycle time comparison

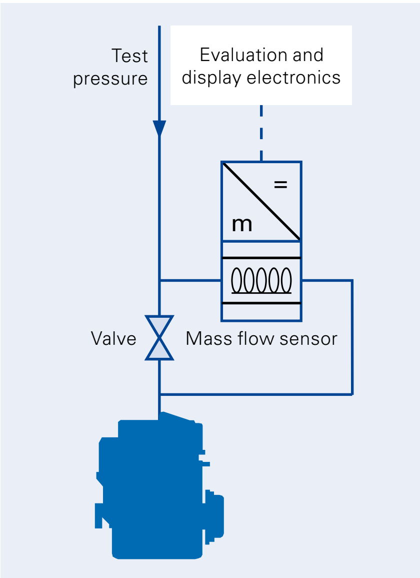
Conventional measuring method and pressurisation vs.
JWF mass flow measurement and pressure balancing method

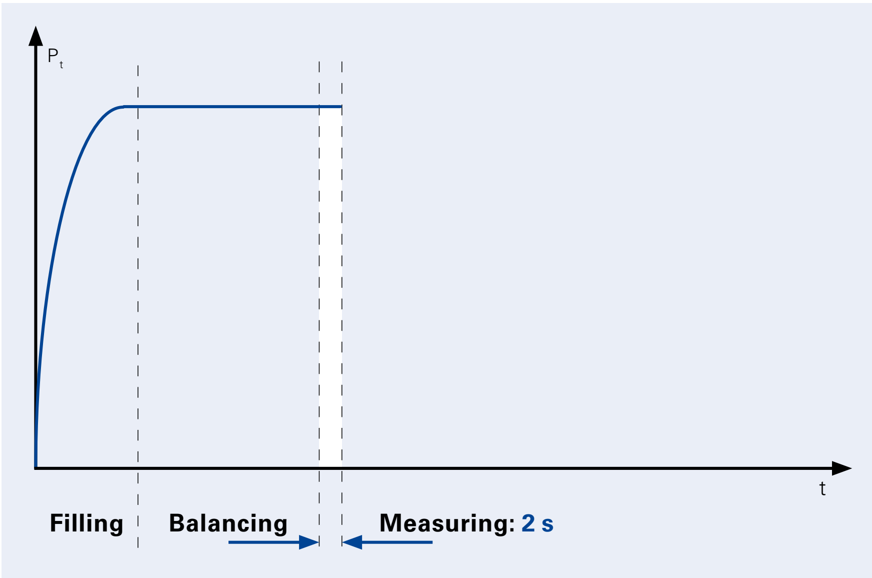
Conventional measuring method and pressurisation



JWF mass flow measurement and pressure balancing method

JWF mass flow measurement

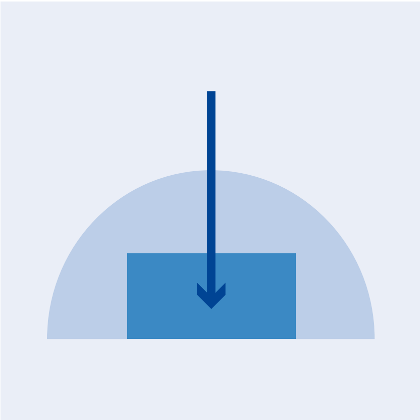




Duration of the measuring phase for leak test on an oil chamber (typical test volume: 25 l)

The JWF mass flow measuring element is almost resistance-free, which allows measurements to be made at a selected point in time.

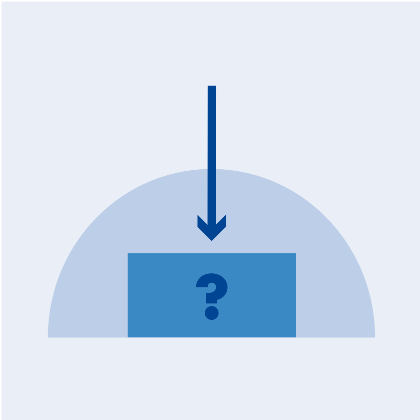
Special measuring procedures



Volume-dependent leak test

Closed hollow bodies with no opening for air to enter are leak tested in a bell jar. After they are placed in the jar, the cavity between the test part and the interior of the bell jar is pressurised. This pressure is generated by an expansion volume from which pressurised air expands into the bell jar during the filling phase. The ratio of the expansion volume to the volume of the cavity, and the pressure in the expansion volume before the filling phase, are chosen in such a way that the test pressure will be reached in the cavity unless the test part has a gross leak (volume measuring principle). In the measuring phase, any fine leaks will be detected via the pressure decay method and gross leaks via pressure monitoring.
To detect gross leaks, it is important for the ratio of the volume in the test part to the remaining test volume to be sufficiently high.

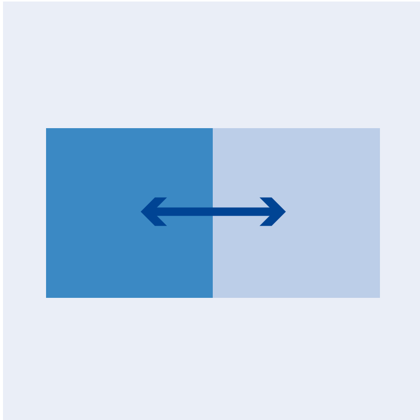
Typical applications
Binoculars
Sensors
Electronic components



Volume measurement

Automatic detection of the volume of a cavity, displayed as the absolute volume or deviation from a reference volume.

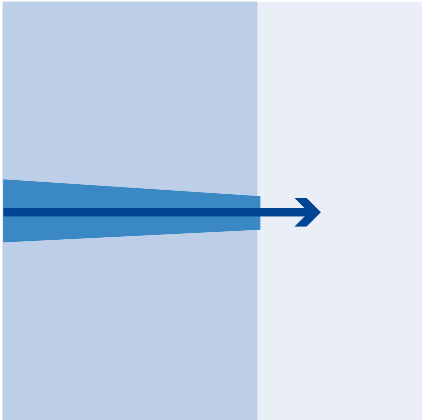
Typical applications
Volume of combustion chambers in cylinder heads
Volume of piston bowls
Viscous couplings



Internal leak test

For internal leakage, two testing spaces are tested for leak tightness in relation to each other.
One example is the dividing surface between the water jacket and the oil chamber in an engine. As the oil chamber generally has the larger test volume, it is initially pressurised with test air while the water jacket remains unpressurised. In this phase, a measuring device with two channels is used to detect whether there is any leakage between the chambers.

Typical applications
Cylinder housing
Engine assemblies



Dynamic pressure testing

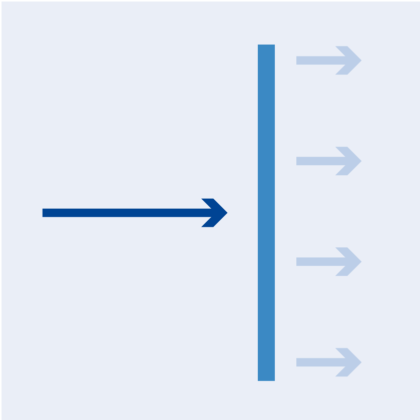
For checking the passage cross section in bored or cast channels: If the passage is occluded or severely narrowed due to casting defects, this can be checked via a “pressure window” using the dynamic pressure method.

Possible tests

- Checking whether passage is obstructed
- Checking whether minimum cross section is present

Typical applications

- Cast parts
- Bores
- Cooling ducts

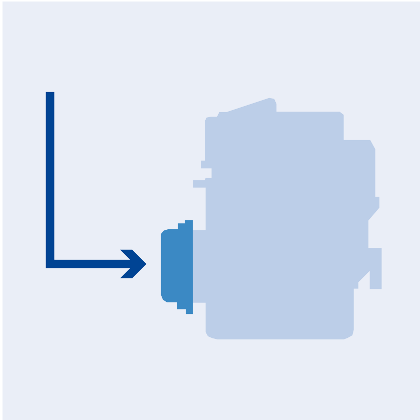


Venting device membrane test

As in functional clothing, venting devices are used, for example, to protect components from external splashing and to dissipate internal moisture into the surrounding environment. When filling via the venting device, the first step is to check whether the membrane is present or has been incorrectly or doubly applied. This check is performed using a “pressure window” or “leakage window”. After an OK result is achieved, filling of the test part continues and the classic leak tightness test is carried out.

Typical applications

- Battery boxes
- Electronic components



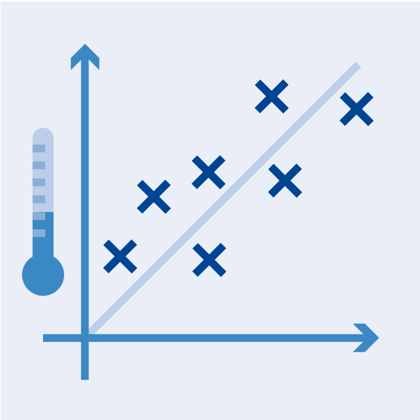
Radial shaft seal test

Extending the measuring circuit makes it possible to test one or more radial shaft seals (depending on the design of the leak test panel) in parallel with the oil chamber leak test. The radial shaft seal is sealed externally by the customer and checked for leak tightness to the oil chamber. At the end of the test, the customer connects the radial shaft seal to the oil chamber via external valves which are controlled by the leak test panel. This ensures that the radial shaft seal no longer leaks during the oil chamber leak test, meaning that these leaks can be assessed entirely separately.

Typical applications

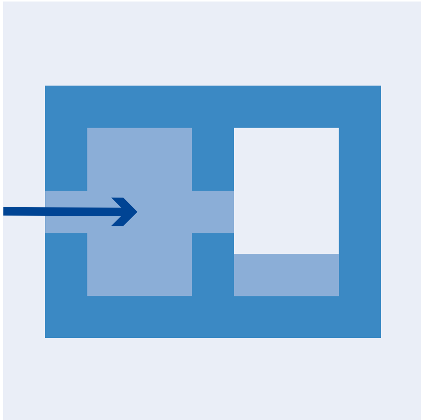
- Radial shaft seal test 1
- Radial shaft seal test 2
- Radial shaft seal test 3

Influencing factors



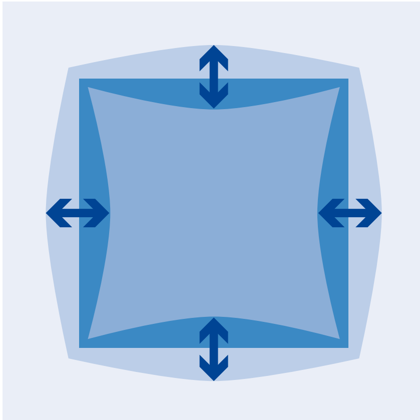
Temperature

The test air temperature must not change during the measuring phase. Any temperature changes which do occur must be precisely reproduced during each measuring process. To meet these requirements, all elements involved in the test, i.e. the test part, test air and sealing device, must have the same temperature or must have the same temperature difference during every test. This can only be approximated under standard production conditions. There are methods which largely compensate for the effect of temperature (JW FROEHLICH patent no. DBP DE 3106981 C2). The ratio of the measuring signal change caused by the allowable leak rate to the measuring signal change caused by the temperature effect determines how necessary it is to carry out temperature compensation.



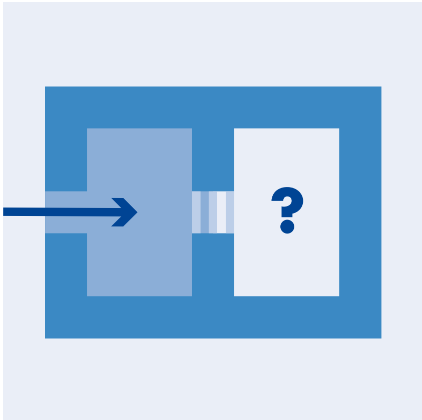
Creeping air

The design of components can cause them to prevent the test air from spreading uniformly and directly in the testing space. It may be the case that spaces behind bottlenecks in various places only fill very slowly. If test air enters these spaces during the measuring phase, this will be misinterpreted as the apparent leak rate, or leaks may not be detected due to an insufficient test pressure.



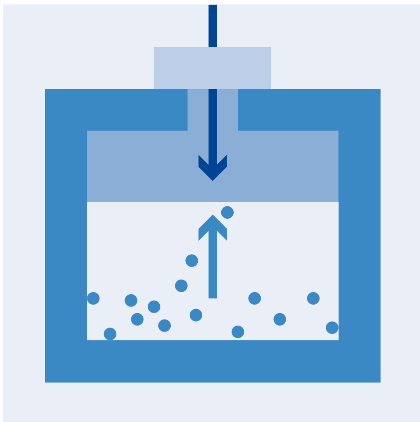
Unstable volumes

The test volume can change during the test under the influence of the test pressure as a result of the materials or construction used. A change in the test volume as a result of the test part "breathing" creates the false impression of a leak during the measuring phase, as the measuring sensor cannot distinguish between a volume increase and actual leakage. Shrinkage – e.g. caused by the pressure forces exerted by the sealing element – may compensate for any leakage. To prevent the sealing elements from "breathing", the rubber seals and the sealing forces should be set in such a way that the sealing elements can no longer shift when sealed.



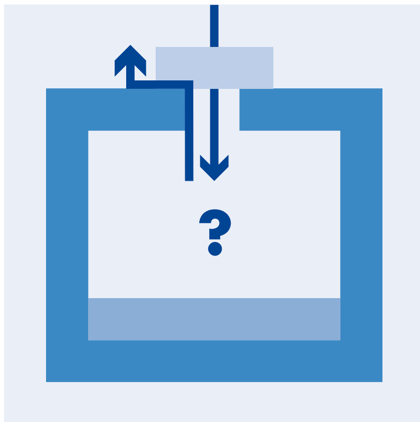
Hidden testing spaces

Hidden testing spaces can lead to misinterpretations. For example, a hidden space may be connected by a non-return valve which opens during the filling phase but closes again once the filling pressure has been reached, meaning that it is disconnected during the leak test. As a result, any leakages in this space will not be detected.



Vaporisation and condensation processes

Moisture on the surface can close up leaks, meaning that they cannot be detected during the leak test. The leaks may then reappear during later use in operating conditions. Dry test parts are thus necessary for the leak test.
In addition, moisture in the testing space causes vaporisation and condensation processes during filling and venting of the test part, which can distort the measurement result.



Leaking pneumatic measuring equipment

The leak test panel is unable to determine whether the leak originates from a porous area of the test part or from leaks in the sealing. If multiple rejects occur in quick succession during production, it may be assumed that the cause is a worn rubber seal or a leak in the test system.

JW Froehlich leak test panels
A solution to meet every need

23 **Industries**
24 **Series**
26 **Panel comparison**
29 **Special functions**
32 **Service from start to finish**

Industries

JW Froehlich leak tightness tests are a key component of quality management in countless companies, and are used to guarantee and document the functionality of many products from a diverse range of industries. With the JW Froehlich leak test panels in Series 100–500 and the JW Froehlich leak calibrators, customers can choose from a range of flexible and versatile devices tailored to their needs.

- Automotive
- Aerospace
- Electrical engineering
- Defence technology
- Household appliances
- Fittings
- Casting
- Valve technology
- Plastics technology
- Medical technology

JW Froehlich leak test panels
Series

Leak Test Panel Series 100
Compact and economical

The Series 100 panels from JW Froehlich are cost-efficient entry-level models, suitable for a wide range of applications, from individual tests to quality control in series production. The panel variants feature impressively simple operating elements. Their low weight and compact size guarantee effortless handling for mobile applications in the workshop.

Leak Test Panel Series 200
Visual and communicative

The professional Series 200 panels can be used as stand-alone devices or as part of a system, and are especially suitable for demanding testing requirements. The comprehensive evaluation of the measuring data and the modern data communication are based on a Windows operating system. A touchscreen makes it easy for operators to navigate the well-organised menu structure while in the workshop, and graphical rendering of the results offers a simple overview of the measuring process.

Leak Test Panel Series 300
Versatile and modular

The leak test panels in Series 300 are the ideal choice for integration into machine lines and production facilities. They make use of the decentralised master/slave principle and satellite technology. The measurement processes running reliably in the background can be visualised on a standard tablet or HMI using the installed CALT software.

Leak Test Panel Series 400

Multifunctional and graphical

The multifunctional panels in the Series 400 from JW Froehlich guarantee short test times. With one or more channels, the systems are able to measure multiple different testing spaces in parallel, and display the results simultaneously on a large touchscreen.

Thanks to their compact design as a closed unit, the panels are ideal for integration into machinery.

Leak Test Panel Series 500

Compact and modular

Part of the JW Froehlich Series 500, these universal panels with their modern user interface can be used as a stand-alone device or as part of a system in machine lines and manufacturing plants. Thanks to the underlying satellite technology and the decentralised master/slave principle behind the panels, measuring processes can also be visualised on a standard tablet or HMI.

Leak Calibrators LK100/800

Lightweight and convenient

The LK100 and LK800 leak calibrators are the optimal accessories for checking and adjusting the JW Froehlich Series 100–500 leak test panels. Convenient to use, battery operated and rechargeable via a USB interface, the measuring devices are flexible and therefore well suited for use in a workshop.

A variable, adjustable leak rate range makes certain that no matter the testing and adjustment tasks, the leak calibrator is fit for use and no additional devices are necessary.

Series 100
The Basic Panel

Series 200
The Professional Panel

Measuring data	MPS100	MPS150	MPS200	MPS250	MFL200	MFL260
Measuring method	Relative pressure	Differential pressure	Relative pressure	Differential pressure	Mass flow rate	
Measurement channels	1		1			
Test programmes	32		32 (256 with Profibus/Profinet)			
Test pressure range	-0.8 to 6 bar	-0.8 to 7 bar	-0.8 to 6 bar	-0.8 to 20 bar	-0.8 to 7 bar	0.7 to 7 bar
Leak rate range (depending on the selected range, other ranges available on request)	± 999.99 cm^3/min		± 999.99 cm^3/min		± 500 cm^3/min	15 cm^3/min. to 100 l/min.
Leak rate measurement resolution	0.01 cm^3/min		0.01 cm^3/min			0.1 cm^3/min. to 0.1 l/min.
Control	**MPS100**	**MPS150**	**MPS200**	**MPS250**	**MFL200**	**MFL260**
Display	4 × 40 character LCD display		6.5″ touchscreen			
Test result storage	up to 500 tests		up to 10,000 tests			
Graphical display	–		TFT colour monitor			
Operating system	Embedded Linux		Windows Embedded Standard 7			
Test result export	TXT		XLS, XML, PDF			
Languages	DE, EN		DE, EN (others on request)			
Communication	**MPS100**	**MPS150**	**MPS200**	**MPS250**	**MFL200**	**MFL260**
Interfaces	Binary I/O, RS 232, USB		Binary I/O, RS 232, USB, and optionally: Profibus, Profinet, etc.			
Q-DAS link	–		○			
Auto-Parameter Module	–		○			
Auto-Mastering Function	–		○			
Barcode scanner incl. software	–		○			
Ethernet	–		○			
TeamViewer remote diagnostics	–		○			
CALT software via PC	–		●			
Accessories	**MPS100**	**MPS150**	**MPS200**	**MPS250**	**MFL200**	**MFL260**
Power unit	○		○			
Leak calibrator LK100/LK800	○		○			
Maintenance unit	○		○			
Temperature compensation	○		○			
Technical data	**MPS100**	**MPS150**	**MPS200**	**MPS250**	**MFL200**	**MFL260**
Dimensions	approx. 160 × 290 × 390 mm		approx. 540 × 220 × 380 mm			
Power supply	24 VDC, 2.5 A		24 VDC, 2.5 A			
Weight	approx. 10 kg		approx. 17 kg			

● = as standard ○ = optional – = not available

Series 300
The Satellite Panel

Series 400
The Multifunctional Panel

MPS300	MPS350	MFL300	MFL360	MPS400	MPS450	MFL400	MFL460
Relative pressure	Differential pressure	Mass flow rate		Relative pressure	Differential pressure	Mass flow rate	
1 (optionally via external PC + CALT up to 8 measuring devices)				multi-channel, 1–8 devices, embedded in the housing			
32 (256 with Profibus/Profinet)				32 (256 with Profibus/Profinet)			
-0.8 to 6 bar	-0.8 to 20 bar	-0.8 to 7 bar	0.7 to 7 bar	-0.8 to 6 bar	-0.8 to 20 bar	-0.8 to 7 bar	0.7 to 7 bar
± 999.99 cm^3/min		± 500 cm^3/min	15 cm^3/min. to 100 l/min.	± 999.99 cm^3/min		± 500 cm^3/min	15 cm^3/min. to 100 l/min.
0.01 cm^3/min			0.1 cm^3/min. to 0.1 l/min.	0.01 cm^3/min			0.1 cm^3/min. to 0.1 l/min.
MPS300	MPS350	MFL300	MFL360	MPS400	MPS450	MFL400	MFL460
4 × 40 character LCD display (opt. w/ ext. PC + CALT: 15″ screen)				15″ touchscreen			
up to 500 tests (opt. w/ ext. PC + CALT: up to 10,000 tests)				up to 100,000 tests			
– (opt. w/ ext. PC + CALT)				TFT colour monitor			
Embedded Linux (opt. w/ext. PC + CALT: Windows Embedded Std 7)				Windows Embedded Standard 7			
TXT (opt. w/ext. PC + CALT: XLS-XML-PDF)				XLS, XML, PDF			
DE, EN (others on request)				DE, EN (others on request)			
MPS300	MPS350	MFL300	MFL360	MPS400	MPS450	MFL400	MFL460
Binary I/O, RS 232, USB, and optionally: Profibus, Profinet, etc.				Profibus, RS 232, USB, and optionally: binary I/O, Profinet, etc.			
○ (CALT)				○			
○ (CALT)				○			
○ (CALT)				○			
○ (CALT)				○			
●				○			
○ (CALT)				○			
○ (CALT)				●			
MPS300	MPS350	MFL300	MFL360	MPS400	MPS450	MFL400	MFL460
○				○			
○				○			
○				○			
○				○			
MPS300	MPS350	MFL300	MFL360	MPS400	MPS450	MFL400	MFL460
approx. 540 × 195 × 405 mm				approx. 575 × 415/500/635/770 × 405 mm (1- to 4-channel panel)			
24 VDC, 2.5 A				24 VDC, 2.5–5 A			
approx. 15 kg				approx. 45–120 kg (1- to 4-channel panel)			

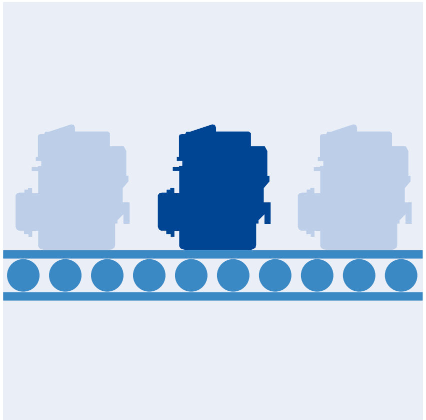
Last updated: 05/18. Subject to technical modifications without notice.

Series 500
The Universal Panel

Measuring data	MPS500	MPS550	MFL500	MFL560
Measuring method	Relative pressure	Differential pressure	Mass flow rate	
Measurement channels	1			
Test programmes	32 (256 with Profibus/Profinet)			
Test pressure range	-0.8 to 6 bar	-0.8 to 20 bar	-0.8 to 6 bar	0.6 to 6 bar
Leak rate range (depending on the selected range, other ranges available on request)	± 999.99 cm^3/min		± 500 cm^3/min	15 cm^3/min. to 100 l/min.
Leak rate measurement resolution	0.01 cm^3/min			0.1 cm^3/min. to 0.1 l/min.
Control	**MPS500**	**MPS550**	**MFL500**	**MFL560**
Display	7″ TFT colour monitor with touchscreen			
Test result storage	up to 100,000 tests			
Graphical display	TFT colour monitor			
Operating system	Windows Embedded Compact			
Test result export	CSV, XML, PDF			
Languages	DE, EN (others on request)			
Communication	**MPS500**	**MPS550**	**MFL500**	**MFL560**
Interfaces	Binary I/O, 2 x USB, and optionally: Profibus, Profinet, Ethernet IP, Barcode			
Q-DAS link	○			
Auto-Parameter Module	○			
Auto-Mastering Function	○			
Barcode scanner incl. software	○			
Ethernet	○			
TeamViewer remote diagnostics	○			
CALT software via PC	●			
Accessories	**MPS500**	**MPS550**	**MFL500**	**MFL560**
Power unit	○			
Leak calibrator LK100/LK800	○			
Maintenance unit	○			
Temperature compensation	○			
Technical data	**MPS500**	**MPS550**	**MFL500**	**MFL560**
Dimensions	approx. 295 × 150 × 390 mm			
Power supply	24 VDC, 2.5 A			
Weight	approx. 8 kg			

Last updated: 05/18. Subject to technical modifications without notice.

Special functions
Auto-Mastering Function



Principle
The Auto-Mastering Function enables fully automatic checking of the test parameters with no human operator required. No special master part is required for this.

Service package

- Software package for controlling and documenting procedures
- Leak simulation for determining linearity

How it works

- The leak test panel selects a suitable production part independently. This removes the need for time-consuming master part management.
- The leak test panel starts the mastering process.
- The time at which this takes place can be set separately for each type of test part via the leak test panel.
- No time-consuming operator interventions or changes to the machine control system are necessary.
- PDF documentation of the inspection can be created. This option can be read out via the panel’s interface.
- The results are additionally available in table format on the device.

Auto Parameter Module

Principle

The Auto Parameter Module is used to determine test parameters semi-automatically.

Service package

Software package for controlling and documenting procedures

Leak simulation for determining linearity

How it works

The software can be operated without significant prior knowledge.

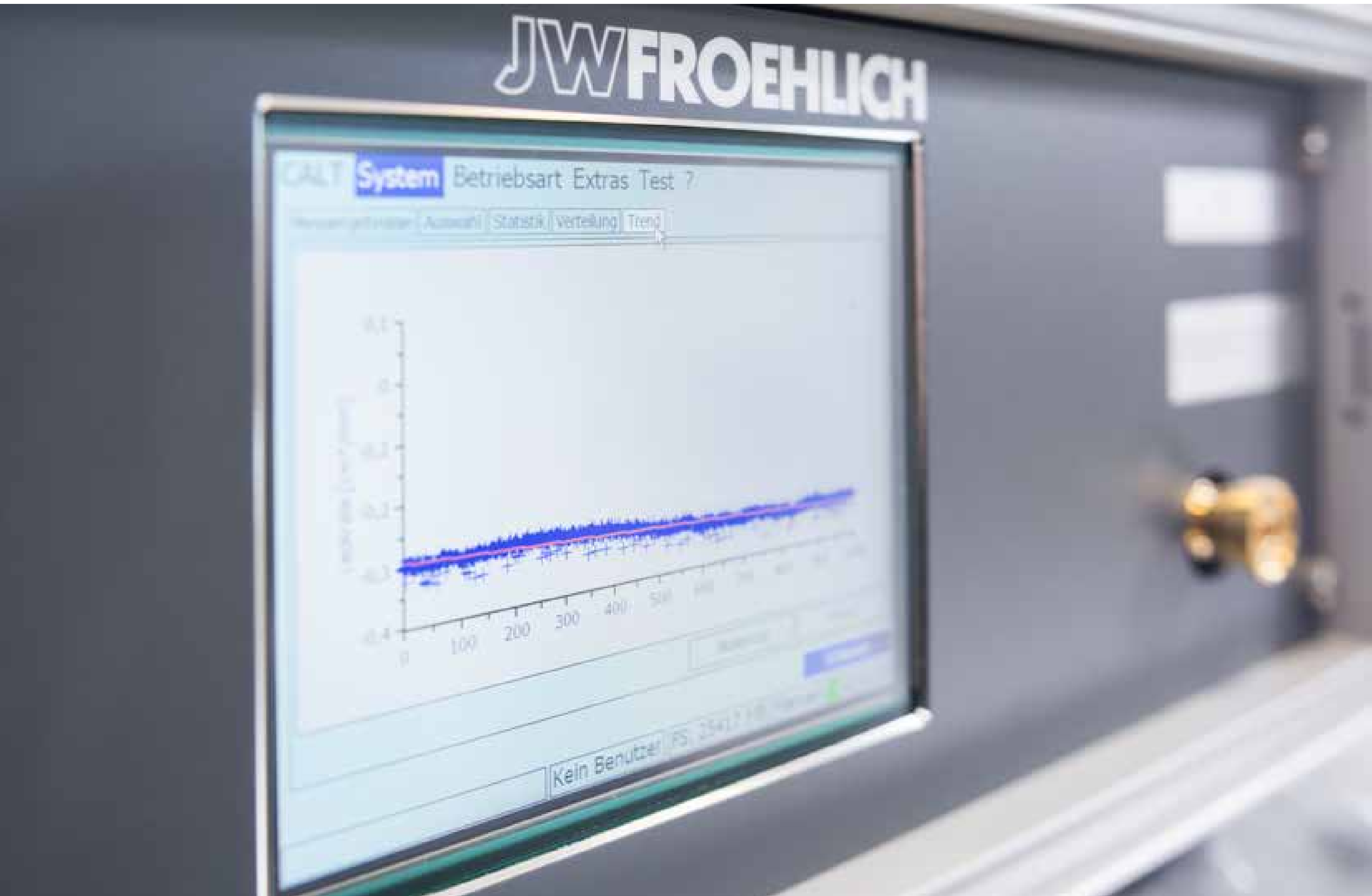
It results in enormous time savings when setting up a new test programme.

The device operates entirely independently.

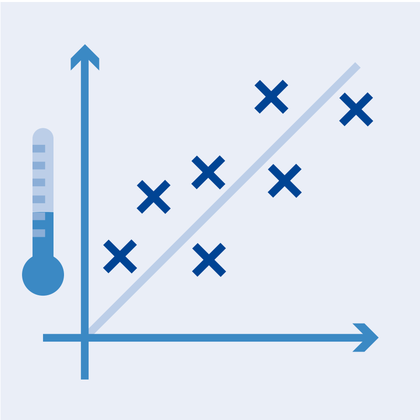
After the data have been input into the existing menu, the device carries out all necessary operations.

This results in a secure setting

which is directly applied in the test programme.



Temperature compensation



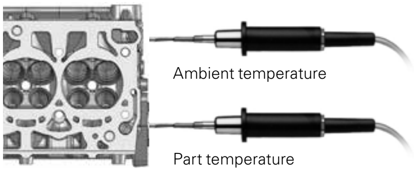
Principle
Compensating for temperature effects on the test part via probes and software

Service package

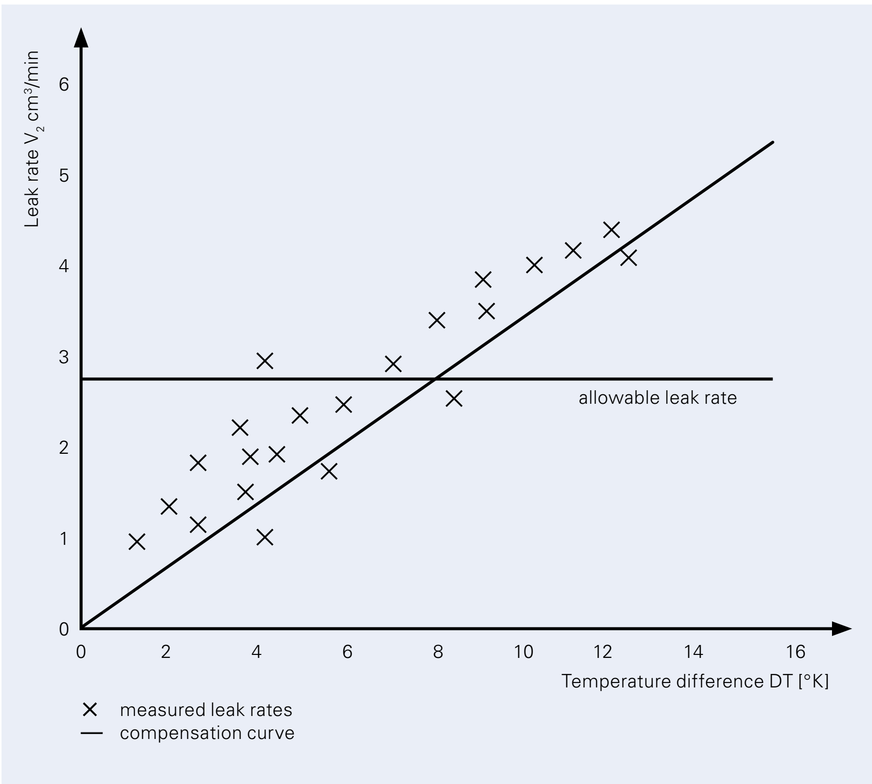
Two probes per measurement channel
Software for determining the compensation rate

How it works

In automatic leak tests with air, the temperature of the test parts and the test air plays an important role. To avoid corrupting the measurement results, the test air temperature must not change during the measuring phase. Any temperature changes which do occur must be precisely reproduced during each measuring process.
The ratio of the measuring signal change caused by the allowable leak to the measuring signal change caused by the temperature effect determines how necessary it is to compensate for the temperature effect. JW Froehlich's temperature compensation makes it possible to reduce the effect of temperature on the measuring signal.
The temperature compensation setup comprises two temperature sensors. One of these is fed to the test part while the other is installed in the proximity of the sealing device and measures the ambient temperature.
In the event of a temperature difference between these two sensors, the compensation value is read from an empirically determined curve and used to offset the leak rate currently measured.



Without temperature compensation:
All parts with a temperature difference larger than 9 kelvins would be qualified as REJECTS in this example.



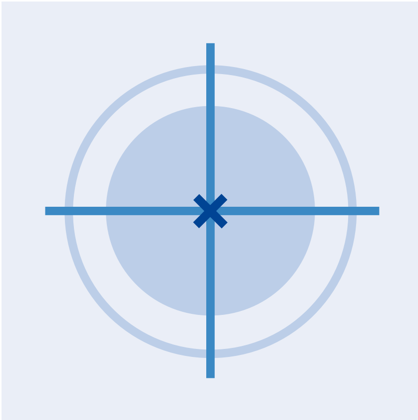
Service from start to finish
Consultation, start-up, support

Alongside our range of leak test panels and calibrators, we also offer our customers a service package tailored to you and your needs, covering a broad spectrum of services from pre-sales advice and online support to analysis and calibration on-site to trainings in-house at JW Froehlich.

Start-up assistance

Assistance with parameterisation

Instruction and training provided on-site by experienced specialists



Calibration

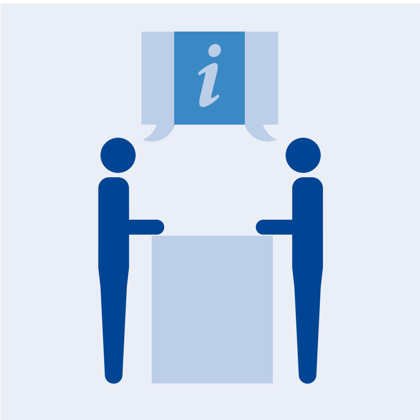
Carried out by experienced specialists either in our factory or at your premises

Factory certificate

Mapping

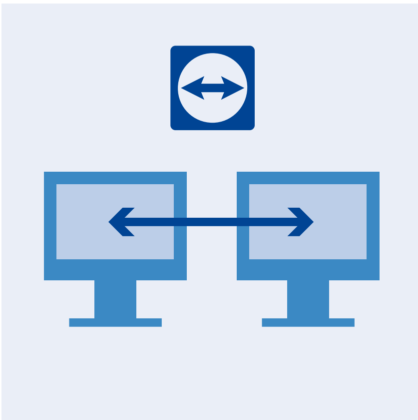
Support from experienced specialists to determine test parameters

Measuring equipment provided



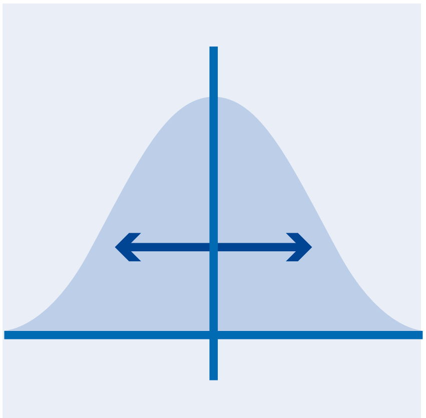
On-site consulting

Demand analysis and support in choosing the right product for you



Panel diagnostic kit

Convenient emergency assistance using online diagnostics via TeamViewer



Measurement system analysis

On-site support on machinery

JW Froehlich leak test training

Training

At the customer's premises or in-house at JW Froehlich

User problems analysed and solved on-site at the customer's premises

Leak tightness tests: Theory and practice

This course will teach you everything you need to know to optimise your work with
JW Froehlich leak test panels. The following topics are covered:

- Test volumes
- Leak rate
- Test time
- Test part behaviour
- Temperature variation
- Measurement system capability

Day 1 of training

Theoretical principles

The following topics are covered:

- The aim of testing
- Terms used
- The different leak test methods
- Influencing factors
- Criteria for equipment construction
- Limits of the method
- Measurement system analysis

Day 2 and 3 of training

Practical seminar

To attend the practical seminar, you must have basic practical knowledge of leak testing or have attended the seminar "Theoretical principles".
The following topics are covered:

- Operating JW Froehlich leak test panels
- Parameterisation for different leak test methods
- Inspection and maintenance of JW Froehlich leak test panels
- Integrating JW Froehlich leak test panels into machine control systems or a data network
- PC programmes in conjunction with JW Froehlich leak test panels

Training sessions offered by JWF Deutschland are typically conducted in German. Our subsidiaries in England and the USA conduct trainings in English and our Chinese subsidiaries conduct trainings in Chinese.

For information, fees, dates and registration, contact us using the details below:

Tel.: +49 (0)71179766-0
Fax: +49 (0)71179766-499
info@jwf.com

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JW Froehlich Maschinenfabrik GmbH
Leak Test Panels Division
www.jwf.com/lecktestgeraete
Design
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www.atelier-rosenberger.de
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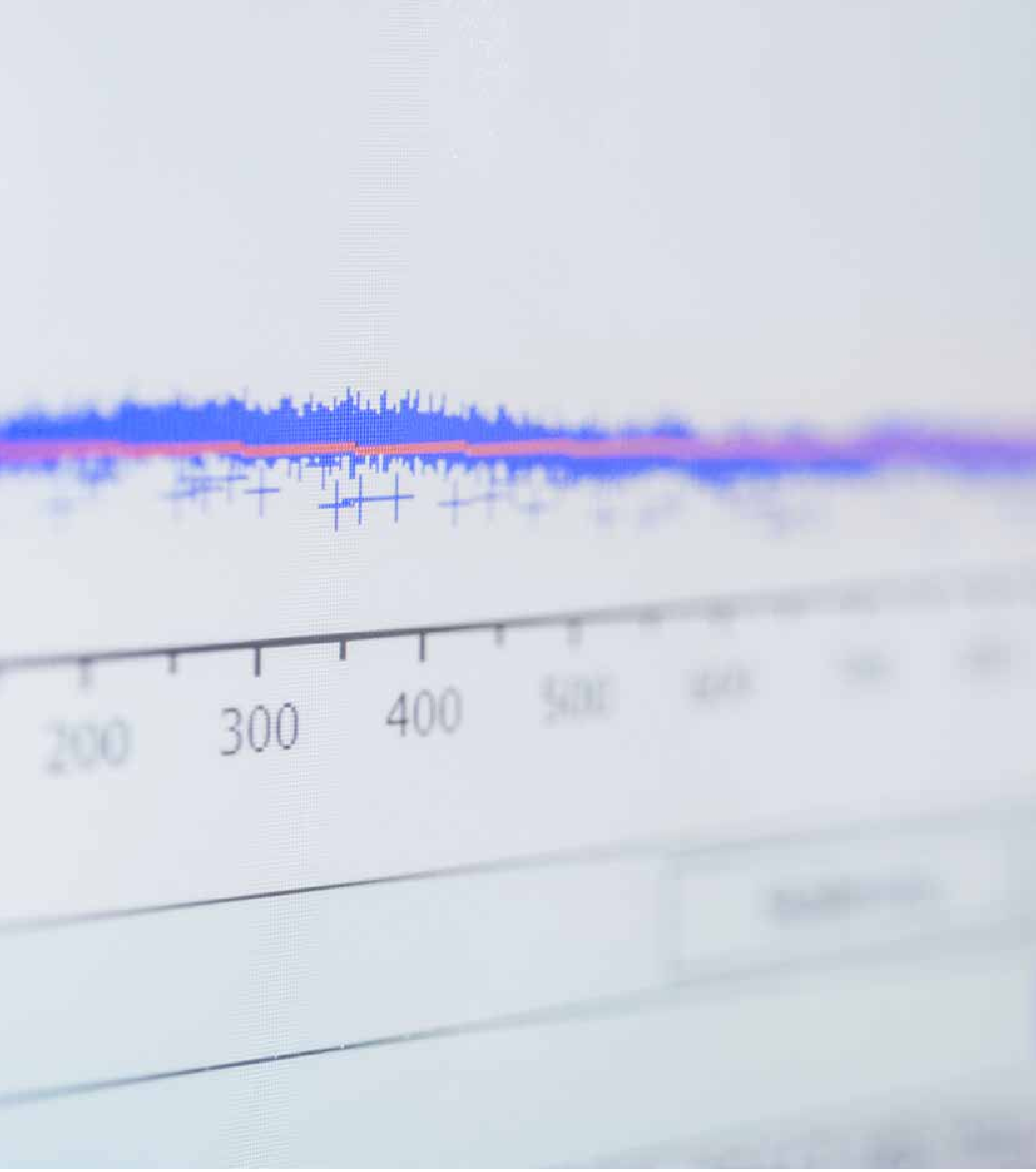

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