oerlikon
leybold vacuum

Leak Testing Instruments

Helium Leak Detectors

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Exhaust filter sets		standard	standard		
Interfaces		standard	standard	standard	standard
Gas ballast facilities		standard			
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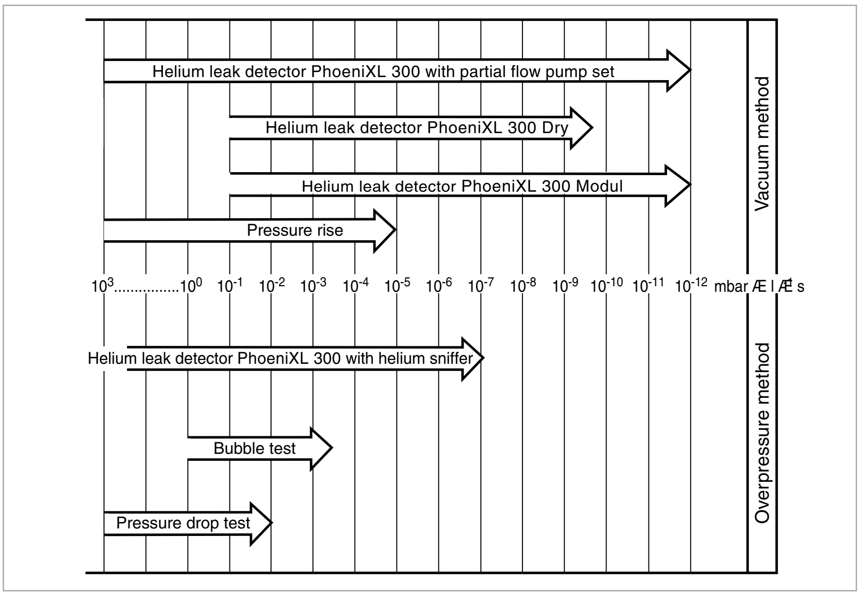
Leak Detection – Leak Testing

Whether a component or a system is leak-tight depends on the application it is to be used in and the leak rate that is acceptable. Absolutely leak-tight components and systems do not exist. A component is considered technically leak-tight if its leak rate remains below a value defined for this particular component. In order to provide a quantitative measure, the term “leak rate” with the symbol “q_L” was introduced. In vacuum technology mbar x l x s^{-1} is used as the unit for leak rates.

A leak rate of 1 mbar x l x s^{-1} exists in a closed vessel having a volume of 1 liter when the pressure increases by 1 mbar within one second, or in case of an overpressure it decreases by 1 mbar within one second.

$$q_L = \frac{V \times \Delta p}{\Delta t} \text{ (mbar x l x s}^{-1}\text{)}$$

The wide range of leak rates from several 100 mbar x l x s^{-1} to below 10^{-11} mbar x l x s^{-1} as they occur in practice necessitates the use of different leak detection principles and hence leak detectors (see figure).



Overview of the leak rate detection ranges

Besides the determination of the total leak tightness, it is usually important to locate the leak, quickly and precisely, in order to seal it. Instruments for local leak detection are called leak detectors. The leak detectors presented in this product section can be used for the localization of leaks, and in addition some are suitable for determining the total leak rate of test objects.

Leak rate	**Pa x m^3 x s^{-1}**	**atm x cm^3 x s^{-1} 1)** **mbar x l x s^{-1} 1)**	**atm x cm^3 x s^{-1} 1)** **cm^3 x s^{-1} 1)**
Pa x m^3 x s^{-1}	1	10	9.87
1 mbar x l x s^{-1} (He)	0.1	1	0.99
1 atm x cm^3 x s^{-1} *) = cm^3 (STP) x s^{-1}	0.101	1.01	1
1 Torr x l x s^{-1}*)	0.133	1.33	1.33
1 kg x h^{-1} air	23.4	234	234
1 g/a $C_2H_2F_4$ (R 134a)	6.41 x 10^{-7}	7.58 x 10^{-6}	6.3 x 10^{-6}

Leak rate	**atm x cm^3 x s^{-1} 1)** **Torr x l s^{-1} 1)**	**kg x h^{-1}** **Air**	**g/a** **$C_2H_2F_4$ (R 134a)**
Pa x m^3 x s^{-1}	7.5	4.28 x 10^{-2}	2.28 x 10^{6}
1 mbar x l x s^{-1} (He)	0.75	4.3 x 10^{-3}	2.28 x 10^{5}
1 atm x cm^3 x s^{-1} *) = cm^3 (STP) x s^{-1}	0.76	4.3 x 10^{-3}	2.3 x 10^{5}
1 Torr x l x s^{-1}*)	1	5.7 x 10^{-3}	3.0 x 10^{5}
1 kg x h^{-1} air	175	1	–
1 g/a $C_2H_2F_4$ (R 134a)	4.8 x 10^{-6}	–	1

1) According to international system of units only Pa x m^3 x s^{-1} is permissible

Leak Detection Methods

There are two main groups of leak detection methods; for both there are special instruments available:

Vacuum Methods

The equipment to be tested is evacuated. The pressure ratio between inside and outside is 0:1.

Overpressure Methods

The equipment to be tested is pressurized with a search gas or a search gas mixture.

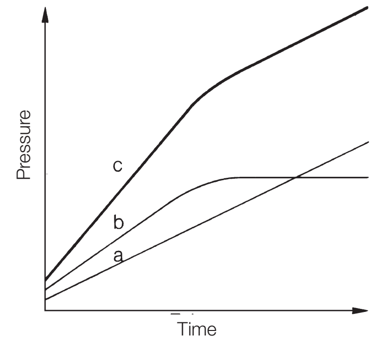
The pressure ratio between inside and outside is over 1:1.

Between the two methods there exist many variations depending on the particular application.

General Notes

1. The lowest leak rates can only be measured by employing the vacuum method, whereby the following applies: The lower the leak rate, the higher the requirements are concerning cleanness and ultimate vacuum.

2. If possible the test objects should be tested under the same conditions that will be used in their final application, i.e. parts for vacuum operation should be tested according to the vacuum method and parts for overpressure operation should be tested using the overpressure method.



a) Pressure rise due to leakage
b) Pressure rise due to outgassing from the chamber walls
c) Both effects combined

Pressure rise in a vacuum chamber after switching off the pump; double log. plot

Leak Testing Based on Vacuum Methods

(Vacuum inside the test object)

Pressure Rise Method

With this method it is only possible to determine the total leak rate. The test object is evacuated with a vacuum pump or a vacuum pump system. A valve is used to isolate the test object from the vacuum pump. The pressure will then rise as a function of time. Curve **(a)** shows the theoretical pressure rise if there is only a leak. Curve **(b)** shows the pressure rise due to outgassing from the surfaces of the test object. This pressure rise tends to tail off in the direction of a saturation level. If in such a case the time allowed for monitoring the pressure rise is too short, a leak will be indicated which in reality does not exist. If one waits long enough for the pressure to rise, i.e. after the bend of curve **(b)** the outgassing process can then be disregarded, so that the leak rate can be determined from the known volume of the test object and the measured pressure rise over a fixed rise time (see equation on page 4). Curve **(c)** shows the pressure rise as it occurs in practice, where outgassing and leak rate add. The detectable leak rate depends on the volume of the test object, the obtained ultimate pressure and the outgassing from the test object. In connection with very large test objects this method is time consuming if extremely low leak rates are to be determined in the fine and rough vacuum range.

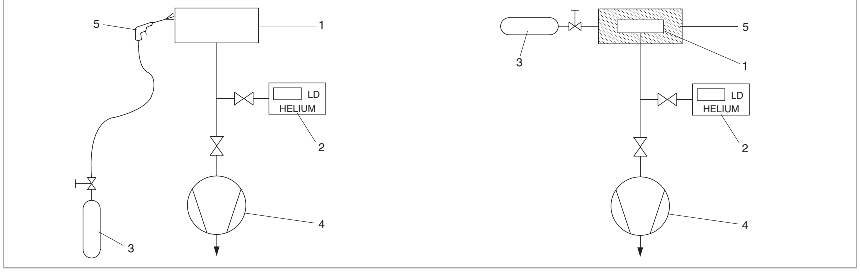
Local Leak Detection

The test object is evacuated by a vacuum pump (auxiliary pump) until the pressure is low enough for the leak detector to operate. When using a helium leak detector, its own pump system will take care of further evacuation. Suspicious spots on the test object will then be sprayed with a fine jet of search gas. Search gas entering through leaks into the test object is pumped out by the vacuum pump and it is converted by the leak detector into an electrical signal which is then displayed. This permits rapid detection and determination of the size of even the smallest leaks.

Integral Method

Determination of the total leak rate of a test object. The testing arrangement is the same as for local leak detection, but in this case the test object is not sprayed with search gas on selected areas, but it is surrounded by a hood or a chamber which is filled with the search gas. Thus the entire outer surface of the test object comes into contact with the search gas. If the search gas enters the test object, the total leak rate is indicated independently of the number of existing leaks. With helium leak detectors it is possible to determine the helium content of the air. This is utilized in the detection of gross leaks.

1 Test object
2 Leak detector
3 Search gas cylinder
4 Vacuum pump
5 Hood
6 Spray gun for search gas
7 Sniffer probe



Local leak detection – Evacuated test object (left) and Integral method – Evacuated test object (right)

Leak Testing Based on Overpressure Methods

(Overpressure within the test object)

Pressure Drop Method

The test object is filled with a gas (for example air or nitrogen) until the testing pressure is reached. Precision vacuum gauges are used to detect a possible pressure drop during the testing period. This method is simple to implement, it is suitable for the determination of gross leaks and can be improved upon by using differential pressure gauges. By applying soap solutions or similar, leaks can be located.

Local Leak Detection with Leak Detectors – Sniffing

The test object is filled with the search gas or the search gas/air mixture to which the leak detector is sensitive. The leak detector is equipped with a sniffer probe, whereby there is a low pressure at the probe tip. If the sniffer tip passes suspicious points on the test object the search gas coming out of the leak is sucked in and transferred to the detection system of the leak detector. After conversion into electrical signals these are displayed optically and acoustically by the leak detector.

Integral Method – Hood Test

To determine the total leak rate of a test object subjected to a search gas overpressure, the test object is surrounded by a hood of a known volume. The search gas which escapes through the leaks collects in the hood.

After a fixed accumulation period a sniffer probe is used to measure the concentration of the search gas which has collected in the hood.

Before this the leak detector should be calibrated by a reference measurement using a known search gas concentration.

The leak rate can then be determined by the equation for q_L where V is the volume of the hood, Δp is the partial pressure difference of the search gas (concentration change) and t is the accumulation period.

Uncertainties in the determination of the volume, leaks in the hood and a wrong accumulation period make precise leak rate measurements based on this method very questionable.

Integral Method – Vacuum Hood Test

This test is a variation of the hood test described above, which has considerable advantages. A vacuum chamber which is evacuated by an auxiliary pump and which is connected to a leak detector is used as the hood. The search gas escaping through the leaks is converted by the detection system of the leak detector into electrical signals which are immediately displayed. After calibration of the leak detector with a calibrated leak it is possible to quantitatively determine the total leak rate.

This method permits the detection of very small leaks and is especially suited for automatic industrial leak detection.

Integral Method – Bombing-Test

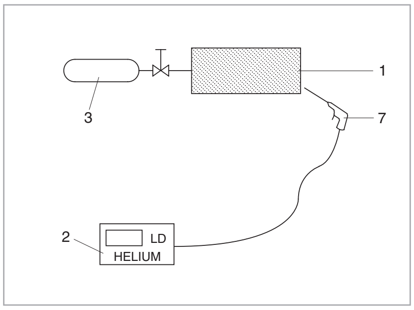
This method is used for testing hermetically sealed components such as transistors, IC-packages or dry reed relays. It is basically a variation of the vacuum hood test. Here the test objects are placed in a vessel which is pressurized with the search gas - preferably helium. At a fairly high search gas pressure and after a period of up to several hours it is tried to enrich the search gas inside leaky test objects. This is the actual so called “bombing” process.

After this, the test objects are transferred to a vacuum chamber and their total leak rate is determined in the same way as in the vacuum hood test. During evacuation of the vacuum chamber down to the required testing pressure, those test objects which have a gross leak already lost their accumulated search gas. These parts are not detected as leaking during the actual leak test. Therefore the test with the vacuum chamber is often preceded by a “bubble test”.

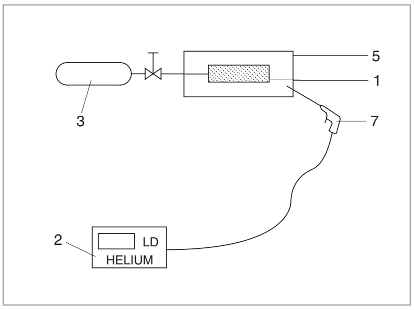
This method permits the detection of the lowest leak rates and is used mainly in automatic industrial leak testing especially when it is not possible to fill the parts with gas in any other way.

Key to the Figures

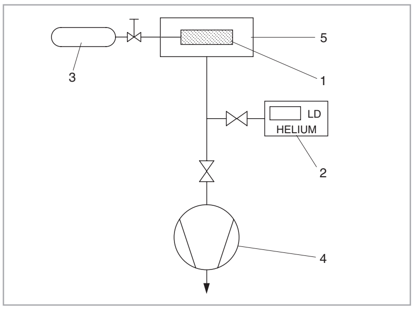
1 Test object
2 Leak detector
3 Search gas cylinder
4 Vacuum pump
5 Hood
6 Spray gun for search gas
7 Sniffer probe



Leak detection –
Search gas overpressure in the test object



Integral method (search gas accumulation)
Search gas overpressure in the test object



Integral methode –
Search gas overpressure in the test object

Operating Principles of the Helium Leak Detectors

Operating Principle

A helium leak detector permits the localization of leaks and the quantitative determination of the leak rate, i.e. the gas flow through the leak. Such a leak detector is therefore a helium flow meter.

In practice the leak detector performs this task by firstly evacuating the part which is to be tested, so that gas from the outside may enter through an existing leak due to the pressure difference present. If only helium is brought in front of the leak (for example by using a spray gun) this helium flows through the leak and is pumped out by the leak detector. The helium partial pressure present in the leak detector is measured by a sector mass spectrometer and is displayed as a leak rate. This is usually given in terms of volume flow of the helium (pV-flow).

Important Specifications

The two most important features of a leak detector are its measurement range (detection limits) and its response time.

The measurement range is limited by the lowest and the highest detectable leak rate. The lowest detectable leak rate is defined by the sum of drift and noise in the most sensitive measurement range. Usually the sum of noise amplitude and zero drift per minute is made to be equivalent to the lowest detectable leak rate. With leak detectors the amount of drift is so low, that the noise amplitude alone determines the detection limit.

The highest detectable leak rate depends strongly on the method employed. Especially the counterflow method and partial flow operation (see description below) permit the measurement of very high leak rates even with a sensitive helium leak detector. In addition the multistage switchable high impedance input amplifiers of the leak detectors also permit the measurement of high leak rates.

In practical applications, especially in the localization of leaks the response time is of great significance. This is the time it takes from spraying the test object with helium until a measured value is displayed by the leak detector. The response time of the electronic signal conditioning circuitry is an important factor in the overall response time. In the case of leak detectors the response time of the electronic circuitry is well below 1 s.

The volume flow rate for helium at the point of the test object is of decisive significance to leak detection on components which are pumped down solely by the leak detector. This volume flow rate provided by the leak detector takes care of the helium entering through a leak and it ensures quick detection by the leak detector. On the other hand the volume of the test object delays the arrival of the helium signal. The response time can be calculated on the basis of the following simple equation:

Response time for helium $t_A = 3 \frac{V}{S_{He}}$

(for 95% of the final value)

with V = Volume of the test object

S_{He} = Volume flow rate for helium at the point of the test object (or at the inlet of the leak detector, if it alone pumps down the test object).

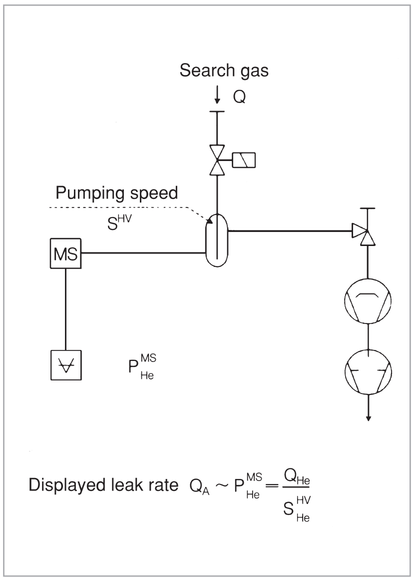
Main Flow Method

The classic operating principle of helium leak detectors is based on the main flow method. Here the entire helium flow passes through the high vacuum system of the leak detector, where the mass spectrometer measures the partial pressure of the helium. In this, the use of a liquid nitrogen cold trap is essential to remove water vapor or other condensible gases in the vacuum system which impair the operation. Moreover, the use of a cold trap permits the low operating pressures for the mass spectrometer to be reached (below 10^{-4} mbar) despite the directly connected (and possibly contaminated) test object.

The advantages of the main flow method are:

- Highest sensitivity, i.e. low detection limit
- Short response time due to a high volume flow rate at the inlet.

The main flow method is thus especially suitable for stationary leak detection on components. Leak detection on systems having their own pump sets and at higher pressures requires the use of an external throttling valve, i.e. a partial flow with subsequently reduced sensitivity is utilized.



Main flow method

Counterflow Method

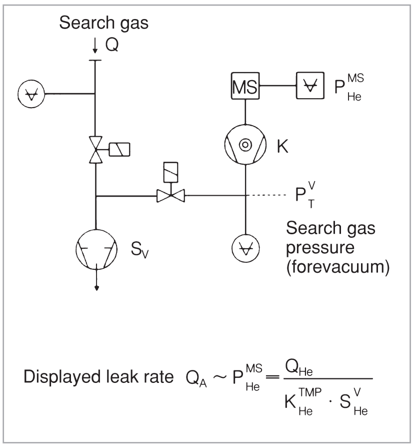
With this method the test object is not connected to the high vacuum. Instead it is connected to the forevacuum (between turbomolecular pump and backing pump), so that the entire gas flow (especially water vapor) does not contribute to the pressure increase in the mass spectrometer. Thus a cold trap is no longer required!

The helium which now enters the forevacuum can still be detected, as it is able to flow against the pumping direction of the turbomolecular pump into the mass spectrometer. This is due to the high particle velocity of the helium. The sensitivity of this counterflow arrangement is equal to that of the main flow principle, provided the right combination of volume flow rate of the backing pump and helium compression of the turbomolecular pump is used.

The advantages of the counterflow method are:

- No liquid nitrogen is required
- High permissible inlet pressures (i.e. pressure within the test object)

This makes the counterflow method especially suitable for mobile leak detection on systems. For leak detection on larger components where a short response time is essential (i.e. high volume flow rate) an additional turbomolecular pump stage is required at the inlet of the leak detector.



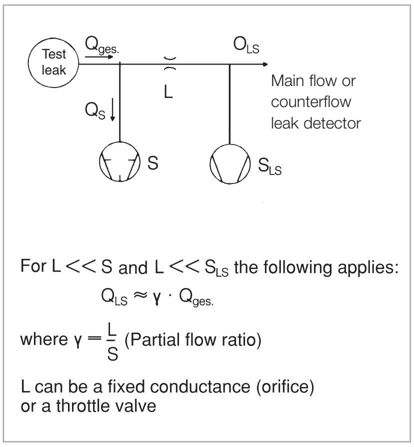
Counterflow method

Partial Flow Method

In order to expand the measurement range in the direction of higher leak rates and for operation at higher inlet pressures, helium leak detectors incorporate a partial flow or a gross leak system. This consists basically of a throttle and a rotary vane pump. At pressures above the normal inlet pressure (main flow: above 10^{-2} mbar, counterflow: above 10^{-1} mbar) or in the case of high helium leak rates, the inlet valve is closed and the main flow is allowed to enter the partial flow pump, whereas only a small part enters the leak detector via the partial flow throttle. Thus the total pressure and the helium pressure are dropped to values suitable for operation of the leak detector.

To obtain correct leak rate readings in the partial flow mode, the partial flow ratio, i.e. the ratio between the actually measured gas flow and the total gas flow must be known and stable.

In all leak detectors this is achieved by a partial flow throttle made of ruby with a precisely machined hole. This ensures that the quantitatively determined leak rates are always correct without calibration, even for gross leaks.



Partial flow method

Calibration of Helium Leak Detectors with Calibrated Leaks

In the process of leak detection one expects that a test object which does not have a leak produces a zero reading on the leak detector. In this any malfunctions are excluded. Thus calibrated leaks, i.e. artificial leaks which produce a known helium leak rate are essential for reliable results.

To obtain a quantitatively correct leak rate reading the sensitivity of the leak detector must also be adjusted. This requires the use of a calibrated leak.

Oerlikon Leybold Vacuum offers calibrated helium leaks of various designs covering the range between 10^{-9} to 10^{-4} mbar x l x s^{-1} as part of the standard range of products. All leak rates are traceable to the standards of the German Calibration Service controlled by the PTB (Federal Institution of Physics and Technology). If requested each helium calibrated leak can be supplied with a calibration certificate issued by the German Calibration Service. The calibration itself is performed by the German Calibration Service for Vacuum which is run by Oerlikon Leybold Vacuum on behalf of the PTB.

Helium Leak Detector PHOENIXL 300

PHOENIXL 300

The PHOENIXL 300 is a portable multi-purpose helium leak detector and equally well suited to both service and series production testing.

Its rugged design and its ease of use make the PHOENIXL 300 to a user-friendly leak detector in its class.

Advantages to the User

- Lowest detectable leak rate
- Short He recovering time condition
- Quick start-up
- Extremely fast response time
- Oil-free gas admission system
- One of the smallest helium leak detectors in the world
- High sensitivity
- Fast leak rate readout also at low leak rates

Typical Applications

Leak tests in connection with

- Quality assurance
- Automotive industry
- Analytical instruments
- Systems manufacture
- Power station engineering
- Research and development
- Semiconductor industry
- High vacuum and ultra-high vacuum engineering
- Ideal tool for industrial series production testing – in the cooling and air conditioning industries, for example

In connection with the sniffer lines which are available as accessories the PHOENIXL 300 may also be used as a sniffer leak detector.

In connection with a partial flow pump set the PHOENIXL 300 may also be used for the detection of leaks on large vessels.

Technical Data

	PHOENIXL 300
Smallest detectable helium leak rate (Vacuum mode) mbar x l x s^{-1}	≤ 5 x 10^{-12}
Smallest detectable helium leak rate (Sniffer mode) mbar x l x s^{-1}	< 1 x 10^{-7}
Max. detectable helium leak rate (Vacuum mode) mbar x l x s^{-1}	> 0.1
Measurement ranges	12 decades
Max. inlet pressure mbar (Torr)	15 (11.25)
Pumping speed during the evacuation process 50 Hz m^3 x h^{-1} (cfm) 60 Hz m^3 x h^{-1} (cfm)	 2.5 (1.5) 3.0 (1.8)
Pumping speed for helium at the inlet l/s	> 2.5
Time constant of the leak signal (blanked off, 63 % of final value) s	< 1
Leak rate measurement range mbar x l x s^{-1}	1 x 10^{-12} to 1 x 10^{-1}
Units of measurement (selectable)	mbar x l x s^{-1}, atm x cc x sec^{-1}, Pa x m^3 x s^{-1}, ppm, Torr x l x s^{-1}, g/a, oz/y
Time until ready for operation min	< 2
Mass spectrometer	180° magnetic sector field
Ion source	2 yttrium/iridium long-life cathodes
Detectable masses amu	2, 3 and 4
Test port DN	1 x 25 KF
Dimensions (W x H x D) mm	495 x 440 x 315
Weight kg (lbs)	40.0 (88.2)

Ordering Information

	PHOENIXL 300
PHOENIXL 300	
EURO version 230 V, 50/60 Hz, mbar readout, with integrated calibrated leak TL 7	**Part No. 250 000**
US version 115 V, 60 Hz, mbar readout, with integrated calibrated leak TL 7	**Part No. 251 000**
Japan version 110 V, 50/60 Hz, mbar readout, with integrated calibrated leak TL 7	**Part No. 251 100**
PC software LeakWare	**Part No. 140 90**
For further accessories see Section "Accessories for PHOENIXL 300, PHOENIXL 300 Dry und PHOENIXL 300 Modul"	

Portable and Dry Helium Leak Detector PHOENIXL 300 Dry

PHOENIXL 300 Dry

The PHOENIXL 300 Dry is a compact portable helium leak detector capable of meeting the highest cleanness requirements.

Based on the well-proven technology of the PHOENIXL 300, equipped with an oil-free pump system, the PHOENIXL 300 Dry meets the highest requirements concerning cleanness while at the same time being small in size.

Advantages to the User

- Oil-free “dry” pump system
- Small footprint
- Quick start-up
- Extremely fast response

Typical Applications

Leak tests with stringent requirements concerning cleanness, for example

- Semiconductor industry
  - after repairs or maintenance work
- Semiconductor industry
  - Production of semiconductor components
- Pharmaceutical/medicine
- Laser

Technical Data

		PHOENIXL 300 Dry
Smallest detectable helium leak rate (Vacuum mode)	mbar x l x s^{-1}	≤ 3 x 10^{-11}
Smallest detectable helium leak rate (Sniffer mode)	mbar x l x s^{-1}	< 1 x 10^{-7}
Max. detectable helium leak rate (Vacuum mode)	mbar x l x s^{-1}	> 0.1
Measurement ranges		12 decades
Max. permissible inlet pressure	mbar (Torr)	15 (11.25)
Pumping speed during the evacuation process 50 Hz 60 Hz	 m^3 x h^{-1} (cfm) m^3 x h^{-1} (cfm)	 1.6 (0.94) 1.9 (1.12)
Pumping speed for helium at the inlet	l/s	> 2.5
Time constant of the leak signal (blanked off, 63 % of final value)	s	< 1
Leak rate measurement range	mbar x l x s^{-1}	1 x 10^{-11} to 1 x 10^{-1}
Units of measurement (selectable)		mbar x l x s^{-1}, atm x cc x sec^{-1}, Pa x m^3 x s^{-1}, ppm, Torr x l x s^{-1}, g/a, oz/y
Time until ready for operation	min	< 2
Mass spectrometer		180° magnetic sector field
Ion source		2 yttrium/iridium long-life cathodes
Detectable masses	amu	2, 3 and 4
Test port	DN	1 x 25 KF
Dimensions (W x H x D)	mm	495 x 456 x 314
Weight	kg (lbs)	35.5 (78.4)

Ordering Information

	PHOENIXL 300 Dry
PHOENIXL 300 Dry Euro version 230 V, 50/60 Hz, mbar readout, with integrated calibrated leak TL 7	**Part No. 250 001**
US version 115 V, 60 Hz, mbar readout, with integrated calibrated leak TL 7	**Part No. 251 001**
Japan version 110 V, 50/60 Hz, mbar readout, with integrated calibrated leak TL 7	**Part No. 251 101**
PC software LeakWare	**Part No. 140 90**
For further accessories see Section “Accessories for PHOENIXL 300, PHOENIXL 300 Dry und PHOENIXL 300 Modul”	

Mobile and Flexible Helium Leak Detector PHOENIXL 300 Modul

PHOENIXL 300 Modul

The PHOENIXL 300 Modul represents the basic unit of an entire family of leak detectors. It is based on the PhoeniXL 300, is not equipped with an integrated backing pump and may be easily adapted by adding an external backing pump to suit a wide range of applications.

The PHOENIXL 300 Modul combines the excellent characteristics of the PHOENIXL 300 with those of the pump system which has been added to the basic leak detector module.

This results in two basic groups:

- Dry, mobile leak detectors with selectable pumping speed
- Oil-sealed, mobile leak detectors offering a high pumping speed at an optimum price-to-performance ratio.

PHOENIXL 300 Modul with Oil-Sealed Backing Pump

This combination represents a powerful leak detector, the pumping speed of which is adapted to the particular application in each case.

Advantages to the User

- Cost-effective leak detector
- Pumping speed optimized for the particular application
- Fast response
- Quick recovery
- High sensitivity
- Fast leak rate readout also at low leak rates

Typical Applications

All applications involving short cycles and/or larger volumes and which require a mobile system, like for example:

- Automotive industry
- Cooling and air conditioning
- Manufacturers of furnaces/ machines/systems
- Packaging

PHOENIXL 300 Modul with Dry-Compressing Scroll Pump

This combination represents a dry high-performance leak detector.

Advantages to the User

- Very high pumping speed which is also acceptable for testing semiconductor production chambers without having to use their own pump systems
- Fast response
- Quick recovery (after helium contamination)
- Absolutely dry
- High sensitivity

Typical Applications

All applications which demand a clean process, like for example:

- Semiconductor industry (chip manufacturers)
- Semiconductor industry (tool manufacturers and subcontractors)
- High purity gas industry
- Research and development
- UHV applications

Technical Data

	PHOENIXL 300 Modul		
	with 1-stage Rotary Vane Pump	**with 2-stage Rotary Vane Pump**	**with Scroll Pump**
Smallest detectable helium leak rate (Vacuum mode) mbar x l x s^{-1}	≤ 5 x 10^{-11}	≤ 5 x 10^{-12}	≤ 8 x 10^{-12} [1)] / ≤ 5 x 10^{-11} [2)]
Smallest detectable helium leak rate (Sniffer mode) mbar x l x s^{-1}	< 1 x 10^{-7}	< 1 x 10^{-7}	< 1 x 10^{-7}
Max. detectable helium leak rate (Vacuum mode) mbar x l x s^{-1}	1 x 10^{-1}	1 x 10^{-1}	1 x 10^{-1}
Max. permissible inlet pressure mbar (Torr)	15 (11.25)	15 (11.25)	15 (11.25)
with partial flow system mbar (Torr)	1000 (750)	1000 (750)	1000 (750)
Pumping speed during the evacuation process with the pump (50 Hz)			
SOGEVAC SV 16 BI m^3 x h^{-1} (cfm)	16 (9.4)	–	–
SOGEVAC SV 28 BI m^3 x h^{-1} (cfm)	25 (14.7)	–	–
SOGEVAC SV 40 BI m^3 x h^{-1} (cfm)	40 (23.6)	–	–
TRIVAC D 16 B m^3 x h^{-1} (cfm)	–	16 (9.4)	–
TRIVAC D 25 B m^3 x h^{-1} (cfm)	–	26 (15.3)	–
SCROLLVAC SC 15 D m^3 x h^{-1} (cfm)	–	–	13 (7.7)
SCROLLVAC SC 30 DL m^3 x h^{-1} (cfm)	–	–	26 (15.3)
Pumping speed for helium at the inlet flange l/s	> 2.5	> 2.5	> 2.5
Time constant of the leak signal (blanked off, 63 % of final value) s	< 1	< 1	< 1
Leak rate measurement range mbar x l x s^{-1}	1 x 10^{-12} to 1 x 10^{-1}	1 x 10^{-12} to 1 x 10^{-1}	1 x 10^{-12} to 1 x 10^{-1}
Units of measurement (selectable)	mbar x l x s^{-1}, atm x cc x sec^{-1}, Pa x m^3 x s^{-1}, ppm, Torr x l x s^{-1}, g/a, oz/y	mbar x l x s^{-1}, atm x cc x sec^{-1}, Pa x m^3 x s^{-1}, ppm, Torr x l x s^{-1}, g/a, oz/y	mbar x l x s^{-1}, atm x cc x sec^{-1}, Pa x m^3 x s^{-1}, ppm, Torr x l x s^{-1}, g/a, oz/y
Time until ready for operation min	≤ 2	≤ 2	≤ 2
Mass spectrometer	180° magnetic sector field	180° magnetic sector field	180° magnetic sector field
Ion source	2 yttrium/ iridium long-life cathodes	2 yttrium/ iridium long-life cathodes	2 yttrium/ iridium long-life cathodes
Detectable masses amu	2, 3 and 4	2, 3 and 4	2, 3 and 4
Test port DN	1 x 25 KF	1 x 25 KF	1 x 25 KF
Dimensions (W x H x D) mm	495 x 440 x 315	495 x 440 x 315	495 x 440 x 315
Weight (without pump) kg (lbs)	30 (66.23)	30 (66.23)	30 (66.23)

1) with SCROLLVAC SC 30 DL
2) with SCROLLVAC SC 15 D

The following Part Nos. contain only the individual components needed for assembly by the customer.

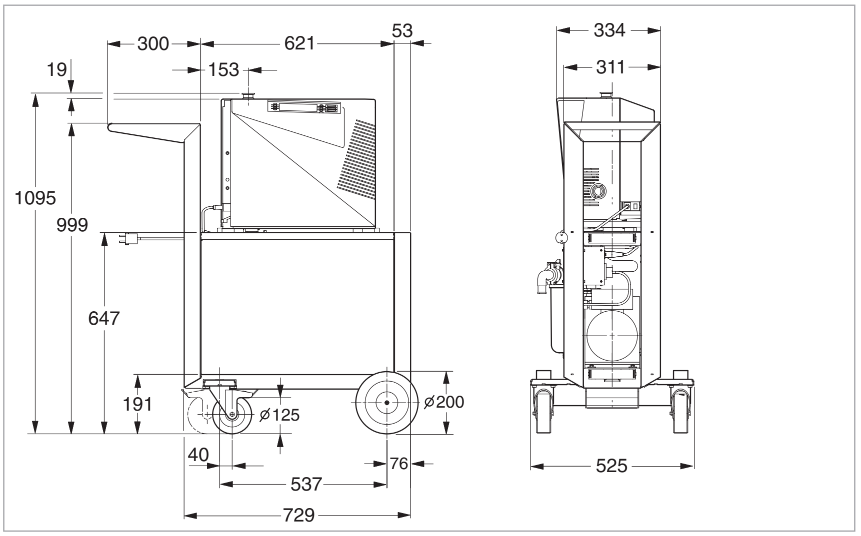
Ordering Information

PHOENIXL 300 Modul

PHOENIXL 300 Modul without backing pump 115 - 230 V / 50/60 Hz	**Part No. 250 002**	**Part No. 250 002**
PC-Software LeakWare	**Part No. 140 90**	**Part No. 140 90**
Recommended backing pumps	**Euro version 230 V, 50 Hz**	**US version 115 V, 60 Hz**
SOGEVAC SV 16 BI	**Part No. 960 286**	**upon request**
SOGEVAC SV 28 BI	**Part No. 960 277**	**upon request**
SOGEVAC SV 40 BI	**upon request**	**upon request**
TRIVAC D 16 B	**Part No. 113 25**	**upon request**
TRIVAC D 25 B	**Part No. 113 35**	**upon request**
SCROLLVAC SC 15 D	**Part No. 133 050**	**Part No. 133 051**
SCROLLVAC SC 30 DL	**Part No. 133 001**	**Part No. 133 101**
For further accessories see Section “Accessories for PHOENIXL 300, PHOENIXL 300 Dry and PHOENIXL 300 Modul”		

CART 300 for PHOENIXL 300

CART 300



Dimensional drawing for CART 300
(here as an example with leak detector and scroll pump SCROLLVAC SC 30 D)

Technical Data

		CART 300
Dimensions (W x H x D)	mm	525 x 1095 x 1024
Weight without leak detector and pump, approx. (here as an example with leak detector and scroll pump SCROLLVAC SC 30 D)	kg (lbs)	50.0 (110.38)

Ordering Information

	CART 300	
	Euro version	**US version**
CART 300		
without E-Box	**Part No. 252 005**	–
with E-Box 230 V, Euro version	**Part No. 252 006**	–
with E-Box 115 V, US version	–	**Part No. 252 007**

PHOENIXL 340
Mobile Helium Leak Detector as Seated Workplace

PHOENIXL 340

The PHOENIXL 340 is a mobile leak testing station to sit in front of. It was developed preferably for testing of small series production parts in the vacuum or the sniffer mode. Through its small footprint and being equipped with 4 wheels it will fit through any standard door.

The integrated standard components comprise PHOENIXL 300 Modul with two-stage, oil-sealed rotary vane pump TRIVAVC D 25 B as well as a power supply and controller unit.

The PHOENIXL 340 is operated through the PHOENIXL 300 operator panel, which for this purpose has been integrated in the front panel of the unit. Operation and technical parameters of the PHOENIXL 340 can be directly derived from the PHOENIXL 300. Optionally, the PHOENIXL 340 may be equipped with an exhaust filter AF16-25 for the TRIVAC, with a dry compressing backing pump SCROLLVAC SC 30 D or also with a remote control.

Advantages to the User

- Mobile, convenient seated workplace
- Simple to operate, identical with the PHOENIXL 300
- Compact size, since only standard components like the PHOENIXL 300 Modul or TRIVAC D 25 B have been integrated
- High detection sensitivity for helium, thus very small leaks can be detected
- Rapid entry in to the ready mode
- High pumping speed due to separate backing pump

Typical Applications

Quality assurance on

- one off and small series production products
- equipment for research and development

Technical Data

Technical Data	PHOENIXL 340
Lowest detectable helium leak rate (vacuum operation) mbar x l x s^{-1}	≤ 5 x 10^{-12}
Maximum detectable helium leak rate (vacuum operation) mbar x l x s^{-1}	> 0.1
Pumping speed during the evacuation process	
with TRIVAC D 25 B (50 Hz) m^3 x h^{-1}	approx. 25
with SCROLLVAC SC 30 DL (60 Hz) m^3 x h^{-1}	approx. 25
Pumping speed for helium at the inlet flange l/s	> 2.5
Time constant of the leak rate signal (blanked off, 63% of the final value) s	< 1
Time until entering the ready mode min	< 2
Dimensions (W x H x D) mm	780 x 1000 x 1000
Height of the bench top mm	750

Ordering Information

Ordering Information	PHOENIXL 340
PHOENIXL 340	**Upon request**

PHOENIXL 320 Fab
Mobile Helium Leak Detector
for Increased Cleanness Requirements

PHOENIXL 320 Fab

PHOENIXL 320 Fab,
with side cover removed

Advantages to the User

- Pleasantly designed mobile leak detector
- Compact dimensions
- High pumping speed due to separate backing pump
- Low particle emissions due to encapsulated backing pump
- Rapid entry in to the ready mode
- High detection sensitivity for helium, thus very small leaks can be detected
- Exclusively standard components have been integrated: convenient access, simple maintenance

Typical Applications

Quality assurance on the following:

- Equipment operated in areas with increased cleanness requirements
- Equipment for research and development
- One off products

The PHOENIXL 320 Fab is a mobile helium leak detector, chiefly designed to be operated in rooms subject to increased cleanness requirements.

A PHOENIXL 300 Modul serves as the helium leak detection unit, the backing pump is a dry compressing SCROLLVAC SC 30 D. Both principal components of the PHOENIXL 320 Fab have been accommodated in a visually pleasing and space saving chassis. In order to significantly suppress the emission of particles, the backing pump has been fitted within an encapsulated housing and is supplied with fresh air from the bottom (fan). The side panels of this housing can be easily removed.

The PHOENIXL 320 Fab is equipped with useful accessories like gas cylinder holder, hooks for the sniffer hoses and mains cord as well as a separate switch for the backing pump.

Technical Data	PHOENIXL 320 Fab
Lowest detectable helium leak rate (vacuum operation) mbar x l x s^{-1}	$\leq 5 \times 10^{-12}$
Lowest detectable helium leak rate (sniffer operation) mbar x l x· s^{-1}	$< 1 \times 10^{-7}$
Maximum detectable helium leak rate (vacuum operation) mbar x l x s^{-1}	> 0.1
Pumping speed during the evacuation process with SCROLLVAC SC 30 DL (50 Hz) $m^3 \times h^{-1}$	ca. 25
Pumping speed for helium in the vacuum mode l/s	> 2.5
Time constant of the leak rate signal (blanked off, 63% of the final value) s	< 1
Time until entering the ready mode min	< 2
Dimensions (W x H x D) mm	450 x 1200 x 1150

Ordering Information	PHOENIXL 320 Fab
PHOENIXL 320 Fab	**Upon request**

Product-Related Accessories

Calibrated Leaks for Vacuum and Sniffer Applications

Test leaks

Calibrated leaks are required for the alignment of mass spectrometers, for the calibration of leak rates and for determining the response time of vacuum systems.

Calibrated Leaks for Vacuum Applications

TL 4 and TL 6

Calibrated leaks without gas reservoir (capillary type of leak) for sensitivity and signal response time determinations during vacuum leak detection and for determination of sniffer sensitivity for overpressure leak detection. Nominal leak rate ranges 10^{-4} mbar x l x s^{-1} for TL 4 and 10^{-6} mbar x l x s^{-1} for TL 6. Suitable for helium. A purging valve with hose nozzle permits a rapid exchange of the gas in the dead volume.

TL 4-6

Helium calibrated leak (capillary leak) for gross leaks, adjustable in the range between 10^{-4} to 10^{-6} mbar x l x s^{-1}, with exchangeable helium reservoir, pressure gauge and two manually operated valves. For calibration of leak rate readings and the alignment of helium mass spectrometers in the vacuum pressure range and for determining the sensitivity of sniffers in the overpressure range.

TL 5

Calibrated helium leak (capillary leak) with reservoir which may be refilled and with a leak rate in the range of 10^{-5} mbar x l x s^{-1}. Special calibrated leak for use in a vacuum.

TL 7

Helium calibrated leak (capillary leak) with helium reservoir and electromagnetically operated valve. Leak rate range 10^{-7} mbar x l x s^{-1}. The electromagnetically operated valve provided permits the opening and closing of the calibrated leak to be controlled by the leak detector’s software.

TL 8 and TL 9

Helium calibrated leak calibrated for a leak rate in the range of 10^{-8} mbar x l x s^{-1} (helium leak rate) for TL 8 and 10^{-9} mbar x l x s^{-1} for TL 9, with gas reservoir and diaphragm shutoff valve. For alignment of a helium mass spectrometer, for calibration of the leak rate display of helium leak detectors and for response time measurements in connection with larger volumes.

Note

All calibrated leaks with the exception of the TL 5 are not suited for use in a vacuum.

Advantages to the User

- Factory certificate (included) in accordance with DIN 55 350-18-4.2.2
- Highly accurate
- Very low temperature dependence
- Determination of the nominal leak rate by comparison with a calibrated leak having a PTB [1)] certificate
- DKD [2)] certificate (optional) traceable to PTB
- Custom models for special applications

The nominal leak rate applies only if the calibrated leak has been connected to a vacuum system at a pressure of less than 1 mbar.

1) Federal Institution of Physics and Technology
2) German Calibration Service

Calibrated Leaks for Sniffer Applications

These calibrated leaks have been set to a fixed value within the typical leak rate range (see Ordering Information). The exchangeable calibration gas reservoir is monitored through the built-in manometer.

Helium calibrated leaks

S-TL 4 to S-TL 6 with leak rates from 10^{-4} to 10^{-6} mbar x l x s^{-1}.

Set of Calibrated Leaks for Power Plants

These three calibrated leaks of 1000, 100 and 10 mbar x l x s^{-1} allow leak tests under partial flow conditions under the ambient conditions of power plants.

Technical Data	Leak Rate Range	Leak Detection Method	Connection Flange
TL 4, without helium gas reservoir	10^{-4} mbar x l x s^{-1}	Vacuum and sniffer	DN 16 KF
TL 6, without helium gas reservoir	10^{-6} mbar x l x s^{-1}	Vacuum and sniffer	DN 16 KF
TL 4-6, with helium gas reservoir	10^{-4} to 10^{-6} mbar x l x s^{-1}	Vacuum and sniffer	DN 16 KF
TL 5, with helium gas reservoir	10^{-5} mbar x l x s^{-1}	Vacuum	Discharging opening
TL 7, with helium gas reservoir	10^{-7} mbar x l x s^{-1}	Vacuum (for installation within the PHOENIXL 300)	Nozzle
TL 8, with helium gas reservoir	10^{-8} mbar x l x s^{-1}	Vacuum	DN 10 KF
TL 9, with helium gas reservoir	10^{-9} mbar x l x s^{-1}	Vacuum	DN 10 KF
S-TL 4, with helium gas reservoir	10^{-4} mbar x l x s^{-1}	Sniffer	Nozzle
S-TL 5, with helium gas reservoir	10^{-5} mbar x l x s^{-1}	Sniffer	Nozzle
S-TL 6, with helium gas reservoir	10^{-6} mbar x l x s^{-1}	Sniffer	Nozzle

Ordering Information	Calibrated Leak
TL 4, without helium gas reservoir [1)]	**Part No. 155 65**
TL 6, without helium gas reservoir [1)]	**Part No. 155 66**
TL 4-6, with helium gas reservoir [1)]	**Part No. 155 80**
TL 5, with helium gas reservoir [1)]	**Part No. 122 67**
TL 7, with helium gas reservoir [1)] for installation within the PHOENIXL 300	**Part No. 140 23**
TL 8, with helium gas reservoir [1)]	**Part No. 165 57**
TL 9, with helium gas reservoir [1]	**Part No. 144 08**
S-TL 4, with helium gas reservoir [1)]	**Part No. 122 37**
S-TL 5, with helium gas reservoir [1)]	**Part No. 122 38**
S-TL 6, with helium gas reservoir [1)]	**Part No. 122 39**
Set of calibrated leaks for power plants 1000, 100, 10 mbar x l x s^{-1}	**Part No. 115 16**
Rubber bladder	**Part No. 200 20 218**
Hose clamp	**Part No. 200 20 217**
Helium can; 1 l, 12 bar (for TL 4-6)	**Part No. 252 001**
DKD calibriation for TL 7/8	**Part No. 154 15**

[1)] with factory certificate

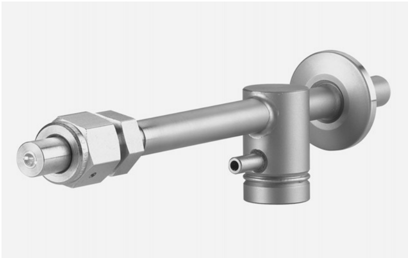
Screw-in Calibrated Leaks

The manufacturers of helium leak testing systems are in need of calibrated leaks of various sizes with individually adjusted leak rates for the purpose of setting up and calibrating their systems.

Depending on the type of application these calibrated leaks are either installed in the test sample as a master leak or used as a continually available facility in the test chamber itself.

Oerlikon Leybold Vacuum is now offering a new family of calibrated leaks which are capable of meeting the requirements concerning type and required leak rate.

Calibrated leak with screw-in sleeve



Calibrated leak with pin type casing

Calibrated leak with cylindrical casing

Calibrated Leak with Screw-in Sleeve

Is used as a so-called master leak to check the entire helium leak testing system.

Generally two leaktight test samples are equipped with these calibrated leaks. These will ensure proper separation between “passed and rejected” parts.

They are fitted to the customer’s test samples either by a welded joint or the screw-in sleeve is glued in place.

Calibrated Leak with Pin Type Casing

Serves as a calibrated leak for the entire helium leak testing system without being influenced by the presence of a test sample.

Here a dummy is placed in the test chamber. The connection to the test chamber is directly by a DN 10 KF fitting. The test gas connection is either by a VCO fitting or a hose nozzle for flexible connections.

Connections on the side of the customer’s system are

- 16 KF running to the vacuum chamber
- Hose nozzle, 10 mm in diameter or VCO fitting, 10 mm in diameter

Calibrated Leak with Cylindrical Casing

Is used to check the sensitivity of a sniffing facility.

Before and after the actual test, the operator checks the sensitivity of his test facility within the scope of a plausibility check.

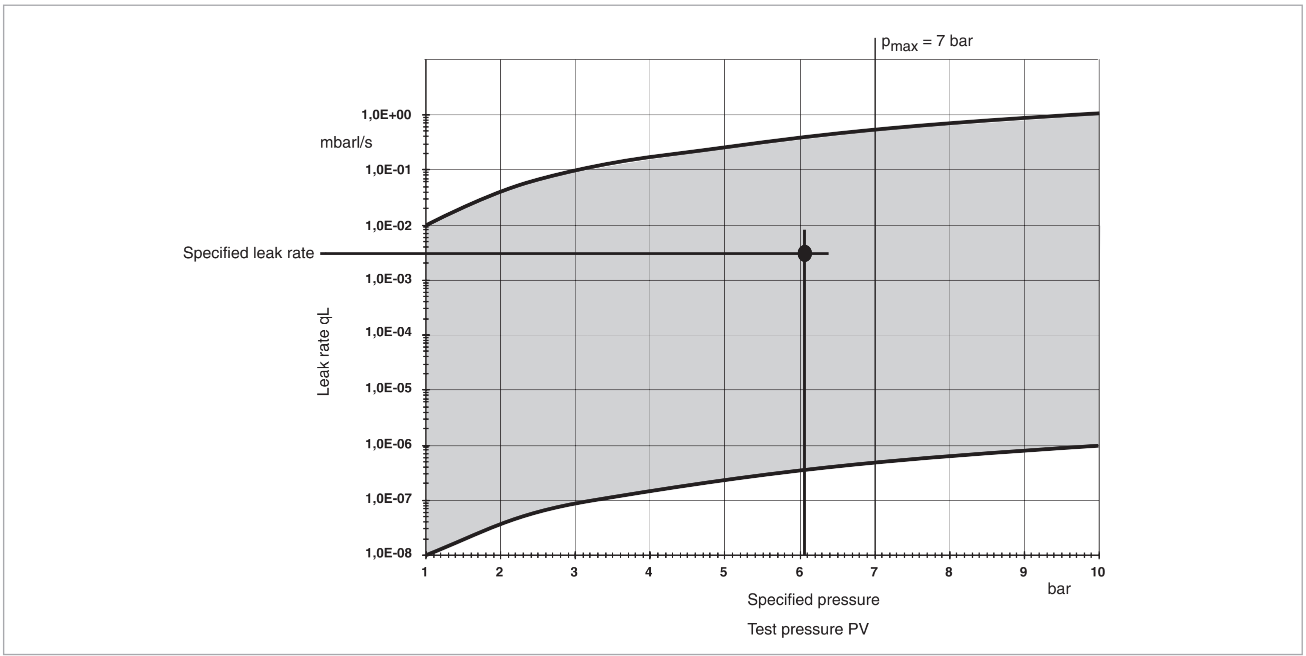
The connection on the side of the customer’s system is provided via a VCO fitting for a diameter of 10 mm.

Typical Applications

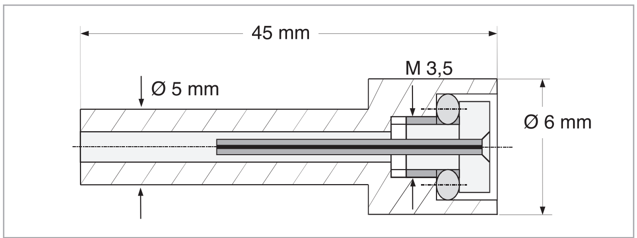
- As a master calibrated leak built-in directly into the test sample
- Directly installed to the test chamber
- Use as a calibrated leak for sniffer applications

Advantages to the User

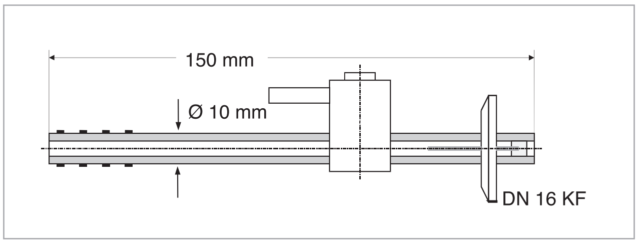
- Various types adapted to different customer requirements
- Simple to operate
- Easy to install
- Ideal installation dimensions
- As a rule, all calibrated leaks are supplied with a certificate (factory certificate) indicating the leak rate which has been set up



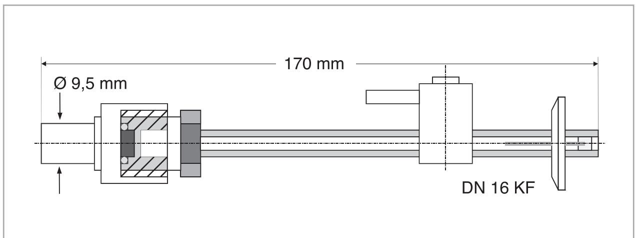
Leak rate as a function of applied forevacuum with reference to 0 bar (> 7 bar upon request)



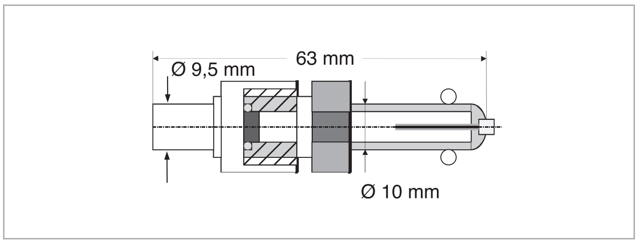
Calibrated leak with screw-in sleeve



Calibrated leak with pin type casing and hose nozzle



Calibrated leak with pin type casing and VCO fitting



Calibrated leak with cylindrical casing and VCO fitting

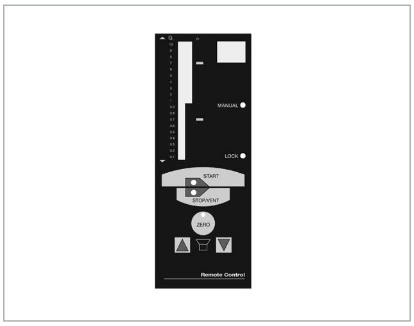
Ordering Information [1)]

Calibrated Leak

Calibrated leak	
with screw-in sleeve	**Part No. 143 00**
with pin type casing and VCO fitting	**Part No. 143 04**
with pin type casing and hose nozzle	**Part No. 143 08**
with cylindrical casing and VCO fitting	**Part No. 143 12**

[1)] When ordering please always state leak rate, test pressure and helium concentration

Accessories for PHOENIXL 300, PHOENIXL 300 Dry and PHOENIXL 300 Modul



Remote control unit

Remote Control Unit

For the PHOENIXL 300, PHOENIXL 300 Dry and PHOENIXL 300 Modul including connection line 4 m and fixing bracket for fixation to the housing of the PHOENIXL 300.

Extension line

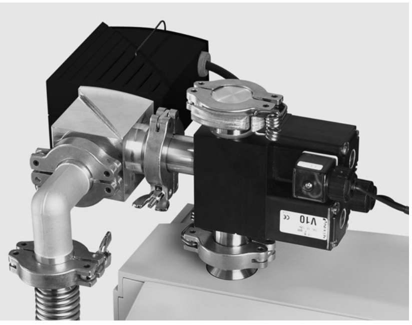
8 m Extension Line

The use of extension lines permits operation of the PHOENIXL 300 up to 30 m away from the test objects.
A maximum of three extension lines (of 8 m each) may be connected in series.

Search gas spray gun

Search Gas Spray Gun

The search gas spray gun with PVC hose (5 m long) is used for well aimed spraying of search gas at places where a leak is suspected.



Partial flow system without pump

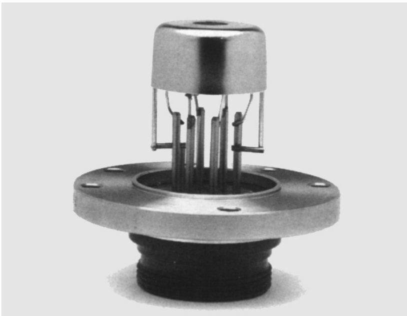
Partial Flow System only for PHOENIXL 300 and PHOENIXL 300 Modul

with following advantages:

- Faster response
- Entry into the measure mode already at an inlet pressure of 1000 mbar.
- Faster venting of large test objects

Equipment:
Valve block (with inlet valve, venting valve, bypass or purging valve) plus right-angle bellows valve DN 25 KF made of stainless steel, solenoid drives, suited for remote control by the PHOENIXL 300.

The partial flow systems are available without pumps.

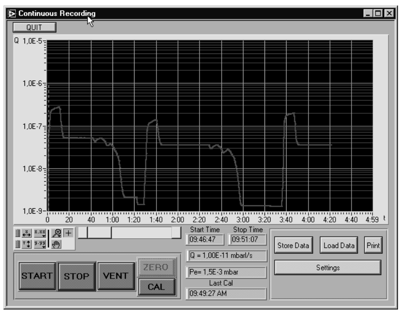


Replacement ion source

Replacement Ion Source

Complete replacement component, including two built-in yttrium coated iridium cathodes

Transport case 300



PC software LeakWare

PC Software LeakWare

The Windows PC software is used for data acquisition, documentation of the measurements and to control the operation of the leak detector.

Hardware > 486 DX and 8 MB Ram
Software Windows 95, 98, NT, 2000.

Transport Case 300

For impact protected transportation of the PHOENIXL 300; complete with strong carrying handles and plastic castors. Separate case for accessories.

Radio Transmitter RT 100

The figure shows the connected radio transmitter RT 100 with receiver and transmitter (leak detector and remote control unit are not included)

Wireless data transfer and control of the helium leak detector over larger distances.

Applications

- Power stations
- Particle accelerators
- Space simulation chambers
- Vacuum furnaces
- Glass coating systems
- Plant construction

Advantages to the User

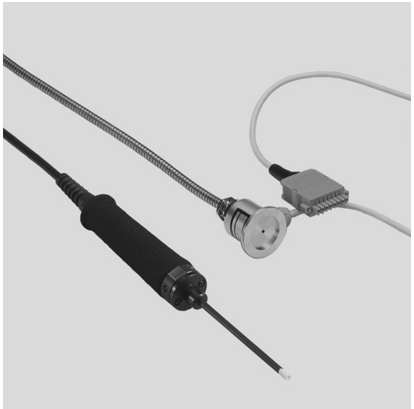
- Wireless data transfer over distances up to 150 m (all functions and leak rate displays on the remote control unit)
- No “spaghetti cable”
- Operator can move freely
- Up to 10 leak detectors can be controlled in the vicinity using the Radio Transmitter RT 100 due to differing channel assignments
- Rechargeable battery allows for 8 hours of operation
- Can be operated by a single operator
- Backwards compatible to L200+, L200, UL200

Ordering Information

	Accessories
Remote control unit including fixing brackets	**Part No. 252 002**
Transport case 300	**Part No. 252 004**
Partial flow system 1) for PHOENIXL 300 and PHOENIXL 300 Modul 115 - 230 V / 50/60 Hz, without pump	**Part No. 140 20**
AF 16-25 exhaust filter, for partial flow system	**Part No. 189 11**
Replacement ion source	**Part No. 165 04**
PC software LeakWare	**Part No. 140 90**
8 m long extension line	**Part No. 140 22**
Search gas spray gun	**Part No. 165 55**
Radio transmitter RT 100	**Part No. 252 009**
Replacement rechargeable battery for Radio Transmitter	**Part No. 252 010**
Software for Radio Transmitter Operator Extension	**Part No. 252 011**

1) 5 centering rings, 5 clamping rings and 1 vacuum hose 1 m with DN 25 KF are included

Helium Sample Probes (Sniffers)



Helium sniffer line SL 300

Helium sniffer QUICK-TEST QT 100 with sniffer

Helium sniffers in connection with the leak detectors are used for leak testing test samples in which a helium over-pressure is present. Besides accurate pinpointing of leaks it is also possible to determine the leak rate of the escaping helium.

Advantages to the User

Helium Sniffer Line SL 300 for PHOENIXL 300

- Sniffer line connects directly at the test connection
- Status LEDs red and green
- ZERO pushbutton
- Easy filter removeable
- Very fast response
- Extremely low detection limit $< 1 \times 10^{-7}$ mbar x l x s^{-1}
- Rigid sniffer tip 120 mm
- Very rugged industrial design

Helium Sniffers QUICK-TEST QT 100 for PHOENIXL 300

- Sniffer leak detection for greater distances between test object and leak detector
- Diaphragm pump for sucking the search gas
- Smallest detectable leak rate 1×10^{-6} mbar x l x s^{-1}
- Short response and decay times
- High sniffer velocity
- Switching power supply, can be run off mains voltages from 100 to 230 V AC

Typical Applications

- Storage and transportation vessels for gases and liquids
- Gas supply systems
- Gas compressors
- Components for the cooling and air conditioning industries
- Heat pumps and components for thermal energy recovery units
- Chemical production plants
- Supply and phone lines laid in the ground
- Power station condensers and turbines
- Window and door seals of car bodies, refrigerators and alike
- Revision checks on leak testing systems
- Measurement of helium concentrations ranging from ppm to %
- All hollow objects exposed to over-pressures

Technical Data		SL 300	QT 100
Smallest detectable leak rate	mbar x l x s^{-1}	$< 10^{-7}$	10^{-6}
Supply voltage		–	100-230 V, 50/60 Hz
Signal response time, approx. at a length of			
5 m	s	< 1	1
20 m	s	–	< 6
50 m	s	–	20
Connection flange	DN	25 KF	25 KF
Weight	kg (lbs)	0.6 (1.3)	3.5 (7.7)

Ordering Information	SL 300	QT 100
Helium sniffer line SL 300 4 m long, straight handle, with red/green LED for go/no-go indication, rigid sniffer tip 120 mm	**Part No. 252 003**	**–**
Helium sniffer QUICK-TEST QT 100	**–**	**Part No. 155 94**
Sniffer line for the QT 100		
5 m	**–**	**Part No. 140 08**
20 m	**–**	**Part No. 140 09**

Miscellaneous

Connection Flanges

Leak Detectors			Helium Sniffers			Calibrated Leaks		
PHOENIXL 300	–	DN 25 KF	SL 300	–	DN 25 KF	TL 4	–	DN 16 KF
PHOENIXL 300 Dry	–	DN 25 KF	QT	–	DN 25 KF	TL 6	–	DN 16 KF
PHOENIXL 300 Modul	–	DN 25 KF	ST 100	–	DN 25 KF	TL 4-6	–	DN 16 KF

If components of the same nominal width are connected, only one centering ring and one clamping ring will be required.

Connection Components

When wanting to connect accessories (helium sniffer and calibrated leaks) to a leak detector, the following reducers and components may be necessary:

Reduction	Reducers	Centering Rings Stainless steel/FPM		Clamping Rings Aluminum	
DN 25 / 16 KF	**Part No. 183 86, Aluminum or** **Part No. 885 04, Stainless steel**	**DN 25 KF,** **DN 16 KF,**	**Part No. 883 47** **Part No. 883 46**	**DN 20 / 25 KF** **DN 10 / 16 KF,**	**Part No. 183 42** **Part No. 183 41**
DN 40 / 25 KF	**Part No. 183 87, Aluminum or** **Part No. 885 05, Stainless steel**	**DN 25 KF,** **DN 40 KF,**	**Part No. 883 47** **Part No. 883 48**	**DN 20 / 25 KF,** **DN 32 / 40 KF,**	**Part No. 183 42** **Part No. 183 43**
DN 40 / 16 KF	**Part No. 183 89, Aluminum or** **Part No. 885 07, Stainless steel**	**DN 16 KF,** **DN 40 KF,**	**Part No. 883 46** **Part No. 883 48**	**DN 10 / 16 KF,** **DN 32 / 40 KF,**	**Part No. 183 41** **Part No. 183 43**

The following metal hoses are recommended to connect the leak detectors to systems:

Nominal Width	Length	Ordering Information
DN 16 KF	1.0 m	**Part No. 868 01**
DN 16 KF	0.5 m	**Part No. 867 91**
DN 25 KF	1.0 m	**Part No. 868 03**
DN 25 KF	0.5 m	**Part No. 867 93**
DN 40 KF	1.0 m	**Part No. 868 05**
DN 40 KF	0.5 m	**Part No. 867 95**

Further connecting components, like quick clamping rings and other components are described in Product Section C13 “Vacuum Fittings and Feedthroughs”

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