O P E R A T I N G I N S T R U C T I O N S

GA 10.198 / 3.02

TL 4
TL 6

Cat. No.
155 65
155 66

Calibrated leaks

INFICON

O P E R A T I N G I N S T R U C T I O N S

GA 10.198 / 3.02

TL 4
TL 6

Cat. No.
155 65
155 66

Calibrated leaks

INFICON

General Note

The right of alterations in the design and the technical data is reserved.
The illustrations are not binding.

Contents

General Note

The right of alterations in the design and the technical data is reserved.
The illustrations are not binding.

Contents

		Page
1	**Technical Data**	3
2	**Standard Specification**	3
3	**Use for Vacuum Leak Test**	3
3.1	Initial turn-on	4
3.2	Turn-off or gas exchange	4
3.3	Checking the response time	4
4	**Use for Pressure Leak Test**	6
4.1	Initial turn-on	6
4.2	Turn-off	6
5	**Using Search Gases other than Helium**	6
6	**Pressure Dependence of the Leak Flow Rate**	9
7	**Handling of Calibrated Leaks**	9
8	**Spare Parts**	9

2

GA 10.198/3.02 - 08/00

1 Technical Data

CALIBRATED LEAK TL 4

Nominal calibration range	10^{-4}*) mbar·l·s^{-1}
Uncertainty of nominal calibration range	$1 \cdot 10^{-5}$ mbar·l·s^{-1}
Temperature coefficient	negligible
Leak type	capillary
Calibrated for	helium
Connecting flange	DN 16 KF
Maximum permissible inlet pressure	5 bar
Cat. No.	155 65

CALIBRATED LEAK TL 6

Nominal calibration range	10^{-6}*) mbar·l·s^{-1}
Uncertainty of nominal calibration range	$1 \cdot 10^{-7}$mbar·l·s^{-1}
Temperature coefficient	negligible
Leak type	capillary
Calibrated for	helium
Connecting flange	DN 16 KF
Maximum permissible inlet pressure	5 bar
Cat. No.	155 66

*) at a differential pressure of 1000 to 1 mbar

2 Standard Specification

2 rubber bladders
2 hose clamps
1 Allan key No. 5
1 calibrated-leak holder with overpressure correction diagram
1 protective filter with DN 16 KF centering ring
1 DN 16 KF centering ring
1 DN 10/16 KF clamping ring

3 Use for Vacuum Leak Test

To check the response time and detection sensitivity of a helium leak detector connected to a vacuum system, fit the CALIBRATED LEAK TL 4 or TL 6 to a connection port on the tested equipment, as far as possible away from the leak detector connection port. The calibrated leak has no shut-off valve. If the continuous inflow of gas through the calibrated leak should be disturbing, fit a bellows-sealed valve between calibrated leak and tested equipment.

Note
It must be taken into account, however, that between closing that valve and opening it again after some time,

1 Technical Data

CALIBRATED LEAK TL 4

Nominal calibration range	10^{-4}*) mbar·l·s^{-1}
Uncertainty of nominal calibration range	$1 \cdot 10^{-5}$ mbar·l·s^{-1}
Temperature coefficient	negligible
Leak type	capillary
Calibrated for	helium
Connecting flange	DN 16 KF
Maximum permissible inlet pressure	5 bar
Cat. No.	155 65

CALIBRATED LEAK TL 6

Nominal calibration range	10^{-6}*) mbar·l·s^{-1}
Uncertainty of nominal calibration range	$1 \cdot 10^{-7}$mbar·l·s^{-1}
Temperature coefficient	negligible
Leak type	capillary
Calibrated for	helium
Connecting flange	DN 16 KF
Maximum permissible inlet pressure	5 bar
Cat. No.	155 66

*) at a differential pressure of 1000 to 1 mbar

2 Standard Specification

2 rubber bladders
2 hose clamps
1 Allan key No. 5
1 calibrated-leak holder with overpressure correction diagram
1 protective filter with DN 16 KF centering ring
1 DN 16 KF centering ring
1 DN 10/16 KF clamping ring

3 Use for Vacuum Leak Test

To check the response time and detection sensitivity of a helium leak detector connected to a vacuum system, fit the CALIBRATED LEAK TL 4 or TL 6 to a connection port on the tested equipment, as far as possible away from the leak detector connection port. The calibrated leak has no shut-off valve. If the continuous inflow of gas through the calibrated leak should be disturbing, fit a bellows-sealed valve between calibrated leak and tested equipment.

Note
It must be taken into account, however, that between closing that valve and opening it again after some time,

search gas (helium) will accumulate before the valve, causing a temporary major deflection on the leak rate meter which does not reflect the real leak rate.

3.1 Initial turn-on

See Figs. 1 and 2.
- Fit rubber bladder (9) with hose clamp (10), rinse once with helium and then fill.
- Connect rubber bladder (9) to calibrated leak (8).
- Open purge valve (1) using allan key No. 5.
- Open hose clamp (10).
- Purge calibrated leak by pressing the rubber bladder.
- Close purge valve (1) again after approx. 15 secs.
- Fit calibrated leak with small flange (2) to the tested equipment. Open bellows-sealed shut-off valve, if fitted.
- Wait for maximum leak rate indication on helium leak detector.

3.2 Turn-off or gas exchange

See Fig. 2.

If a bellows-sealed shut-off valve is interconnected, it must be closed. Where no shut-off valve is fitted and for gas exchange in the calibrated leak, proceed as follows:
- Close hose clamp (10) and interchange rubber bladder (9), as necessary.
- Connect a small vacuum pump (13) to the hose nozzle (6) of the purge valve (1).
- Open purge valve (1) and suck off helium.

3.3 Checking the response time

See Fig. 3.

The test arrangement of the calibrated leak shown in Fig. 3 enables an exact determination of the response time.
- Put calibrated leak into operation according to 3.1 but the shut-off valve (16) remains closed.
- Open valve (22) to the vacuum pump (13).
- To enable determination of the response time, open shut-off valve (16) and at the same time close valve (22).
- Take the time elapsing till maximum leak rate indication on the meter.

Generally, for leak testing a leak signal amounting to 63 % of the nominal leak rate will be satisfactory. In factory acceptance tests, however, wait for maximum leak rate indication.

If the helium leak detector is used in partial flow operation, not the nominal leak rate but a lower value depending on the total-to-partial flow ratio will be indicated.

search gas (helium) will accumulate before the valve, causing a temporary major deflection on the leak rate meter which does not reflect the real leak rate.

3.1 Initial turn-on

See Figs. 1 and 2.
- Fit rubber bladder (9) with hose clamp (10), rinse once with helium and then fill.
- Connect rubber bladder (9) to calibrated leak (8).
- Open purge valve (1) using allan key No. 5.
- Open hose clamp (10).
- Purge calibrated leak by pressing the rubber bladder.
- Close purge valve (1) again after approx. 15 secs.
- Fit calibrated leak with small flange (2) to the tested equipment. Open bellows-sealed shut-off valve, if fitted.
- Wait for maximum leak rate indication on helium leak detector.

3.2 Turn-off or gas exchange

See Fig. 2.

If a bellows-sealed shut-off valve is interconnected, it must be closed. Where no shut-off valve is fitted and for gas exchange in the calibrated leak, proceed as follows:
- Close hose clamp (10) and interchange rubber bladder (9), as necessary.
- Connect a small vacuum pump (13) to the hose nozzle (6) of the purge valve (1).
- Open purge valve (1) and suck off helium.

3.3 Checking the response time

See Fig. 3.

The test arrangement of the calibrated leak shown in Fig. 3 enables an exact determination of the response time.
- Put calibrated leak into operation according to 3.1 but the shut-off valve (16) remains closed.
- Open valve (22) to the vacuum pump (13).
- To enable determination of the response time, open shut-off valve (16) and at the same time close valve (22).
- Take the time elapsing till maximum leak rate indication on the meter.

Generally, for leak testing a leak signal amounting to 63 % of the nominal leak rate will be satisfactory. In factory acceptance tests, however, wait for maximum leak rate indication.

If the helium leak detector is used in partial flow operation, not the nominal leak rate but a lower value depending on the total-to-partial flow ratio will be indicated.

4

GA 10.198/3.02 - 08/00

Key to Figs. 1 and 2

1 Purge valve
2 DN 16 KF connecting flange
3 Centering ring with protective filter
4 Capillary
5 Inlet filter
6 Hose nozzle
8 CALIBRATED LEAK TL 4 or TL 6
9 Rubber bladder
10 Hose clamp
11 Vacuum tubing
12 Small flange with hose nozzle
13 Vacuum pump
14 Leak tested equipment

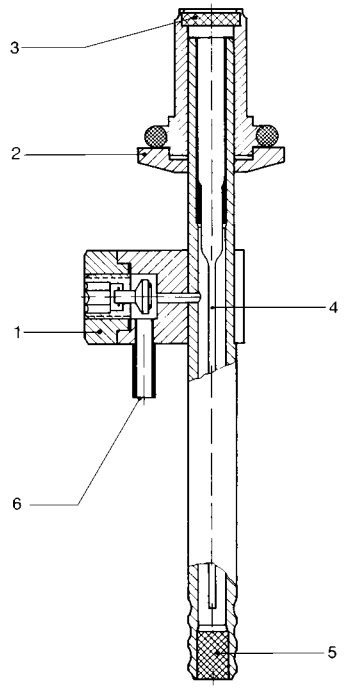

Fig. 1 CALIBRATED LEAKS TL 4 and TL 6

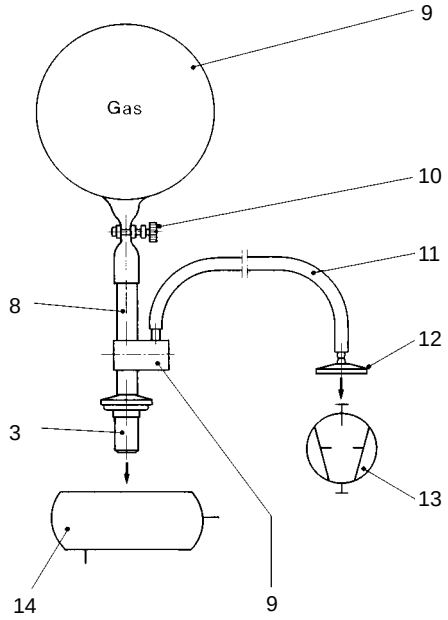

Fig. 2 Gas exchange

Key to Figs. 1 and 2

1 Purge valve
2 DN 16 KF connecting flange
3 Centering ring with protective filter
4 Capillary
5 Inlet filter
6 Hose nozzle
8 CALIBRATED LEAK TL 4 or TL 6
9 Rubber bladder
10 Hose clamp
11 Vacuum tubing
12 Small flange with hose nozzle
13 Vacuum pump
14 Leak tested equipment

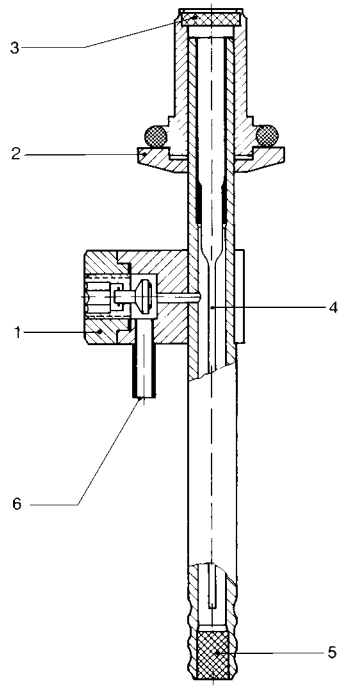

Fig. 1 CALIBRATED LEAKS TL 4 and TL 6

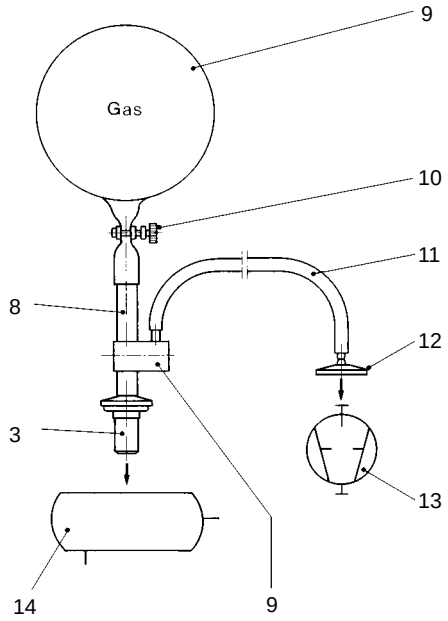

Fig. 2 Gas exchange

GA 10.198/3.02 - 08/00

5

4 Use for Pressure Leak Test

For response time and sensitivity checking of helium and halogen sample probes, use the CALIBRATED LEAKS TL 4 or TL 6 in combination with the calibrated-leak holder included in the standard equipment.

4.1 Initial turn-on

- Flange calibrated leak to calibrated-leak holder.
- Connect calibrated leak with pressure tubing to search gas cylinder.
- Open gas-cylinder valve.
- Set pressure reducing valve to an overpressure > 1 bar.
- Open purge valve (1) briefly and close again using Allan key No. 5.
- Adjust search gas pressure to an even value.
- By means of the rear side diagram on the calibrated-leak holder, determine the actual flow rate of the calibrated leak.
- Apply the sample probe tip directly to the search gas emission opening of the calibrated leak and note the leak flow rate.
- For dynamic sensitivity checking, simulate leak testing of equipment by moving the probe tip at a maximum distance of 5 mm and 10 mm·s^{-1} scanning speed along the graduated line.

4.2 Turn-off

- Close gas-cylinder valve.
- Relieve search-gas tubing from pressure by opening purge valve (1) using Allan key No. 5.
- Remove tubing from calibrated leak.
- Disconnect calibrated leak from leak holder and replace filter cap.

5 Using Search Gases other than Helium

The nominal flow rate of CALIBRATED LEAKS TL 4 and TL 6 is determined for helium. If the calibrated leak is to be used with another gas, the nominal value must be calculated anew using the conversion factor for that specific gas. The calculation of a conversion factor depending on the type of gas implies major inaccuracies, particularly for the CALIBRATED LEAK TL 6 since the effective flow phenomena within a capillary are unknown. Molecular flow conditions can only be assumed for leaks ≤ 10^{-8} mbar·l·s^{-1} and laminar flow conditions for leaks

4 Use for Pressure Leak Test

For response time and sensitivity checking of helium and halogen sample probes, use the CALIBRATED LEAKS TL 4 or TL 6 in combination with the calibrated-leak holder included in the standard equipment.

4.1 Initial turn-on

- Flange calibrated leak to calibrated-leak holder.
- Connect calibrated leak with pressure tubing to search gas cylinder.
- Open gas-cylinder valve.
- Set pressure reducing valve to an overpressure > 1 bar.
- Open purge valve (1) briefly and close again using Allan key No. 5.
- Adjust search gas pressure to an even value.
- By means of the rear side diagram on the calibrated-leak holder, determine the actual flow rate of the calibrated leak.
- Apply the sample probe tip directly to the search gas emission opening of the calibrated leak and note the leak flow rate.
- For dynamic sensitivity checking, simulate leak testing of equipment by moving the probe tip at a maximum distance of 5 mm and 10 mm·s^{-1} scanning speed along the graduated line.

4.2 Turn-off

- Close gas-cylinder valve.
- Relieve search-gas tubing from pressure by opening purge valve (1) using Allan key No. 5.
- Remove tubing from calibrated leak.
- Disconnect calibrated leak from leak holder and replace filter cap.

5 Using Search Gases other than Helium

The nominal flow rate of CALIBRATED LEAKS TL 4 and TL 6 is determined for helium. If the calibrated leak is to be used with another gas, the nominal value must be calculated anew using the conversion factor for that specific gas. The calculation of a conversion factor depending on the type of gas implies major inaccuracies, particularly for the CALIBRATED LEAK TL 6 since the effective flow phenomena within a capillary are unknown. Molecular flow conditions can only be assumed for leaks ≤ 10^{-8} mbar·l·s^{-1} and laminar flow conditions for leaks

6

GA 10.198/3.02 - 08/00

Key to Fig. 3

1 Purge valve
8 CALIBRATED LEAKS TL 4 or TL 6
9 Rubber bladder
10 Hose clamp
13 Auxiliary vacuum pump
14 Tested equipment
15 Tee DN 16 KF
16 Bellows-sealed shut-off valve DN 16 KF
17 Vacuum pump line
18 Vacuum pump system
19 Valve
20 Throttle valve
21 Helium leak detector
22 Bellows-sealed shut-off valve DN 16 KF

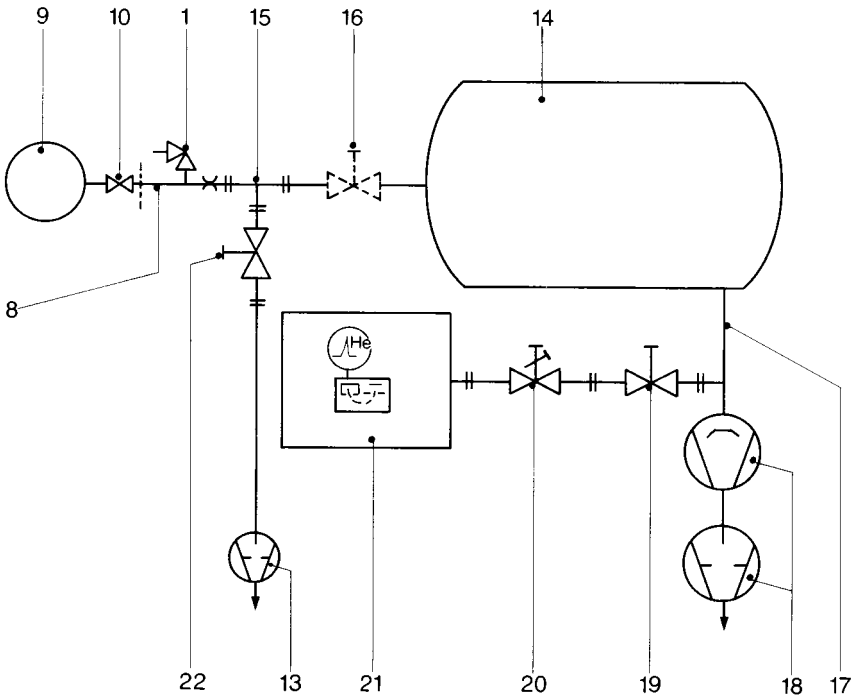

Fig. 3 Determining the response time

Key to Fig. 3

1 Purge valve
8 CALIBRATED LEAKS TL 4 or TL 6
9 Rubber bladder
10 Hose clamp
13 Auxiliary vacuum pump
14 Tested equipment
15 Tee DN 16 KF
16 Bellows-sealed shut-off valve DN 16 KF
17 Vacuum pump line
18 Vacuum pump system
19 Valve
20 Throttle valve
21 Helium leak detector
22 Bellows-sealed shut-off valve DN 16 KF

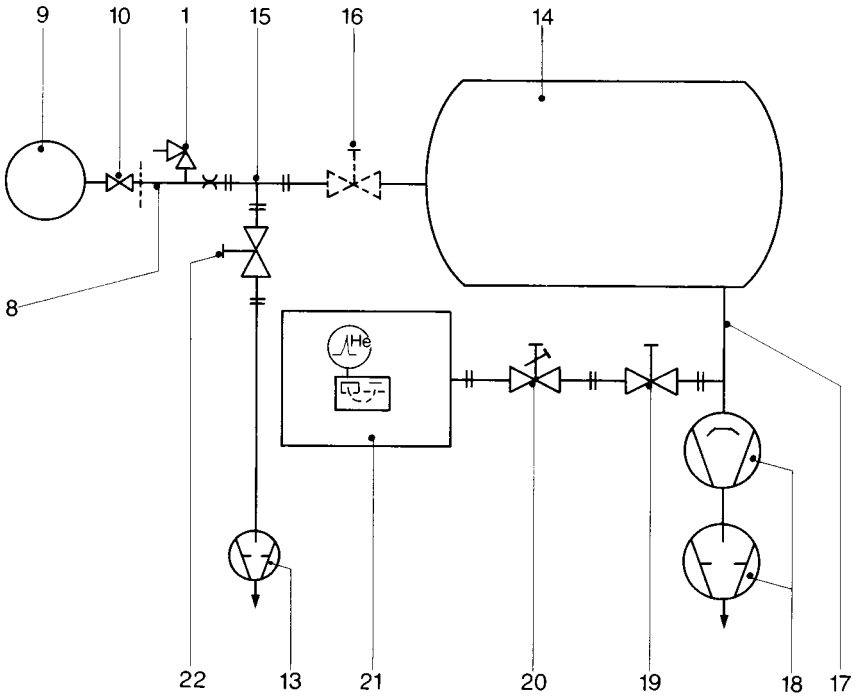

Fig. 3 Determining the response time

$\geq 10^{-4}$ mbar·l·s^{-1}. As the flow rate of CALIBRATED LEAK TL 6 is between molecular and laminar flow, the correction factor can merely be assessed. Calibrated leak capillaries are manufactured by hand as single pieces and have varying lengths and diameters and hence varying flow profiles affecting the conversion factor.

CALIBRATED LEAK TL 4

For CALIBRATED LEAK TL 4, the correction factor can be determined with sufficient accuracy from the ratio of the viscosity of helium to that of the other search gas to be used.

$$K = \frac{Q_{Gas\ x}}{Q_{He}} = \frac{\eta_{He}}{\eta_{Gas\ x}}$$ η : dyn.-Viscosity

Care must be taken that these viscosities are for the same temperature. The dynamic viscosity η in 10^{-6} kg·m^{-1}·s^{-1} (20 °C)**1)** is given for 5 frequently used gases:

	He	CF_2Cl_2	N_2O_2	Ar	H_2
η	1,96	1,32	1,82	2,21	0,88

1) according to Theorie und Praxis der Vakuumtechnik Vieweg-Verlag, 2nd edition.

CALIBRATED LEAK TL 6

As explained above, a correction factor cannot be exactly calculated. Only an approximate correction can be achieved by assessing a factor between those indicated for laminar and for molecular flow The correction factor for the molecular flow range is calculated from the square root of the ratio of the relative molecular masses of helium and the other search gas used.

$$K = \frac{Q_{Gas\ x}}{Q_{He}} = \sqrt{\frac{M_{He}}{M_{Gas\ x}}}$$ M: Molecular masses

For this type of calibrated leak used in pressure leak testing with halogen leak detectors, a correction factor of 35 was determinded, based on the commercially available „baby“ freon cylinders with a pressure of 5.8 bar at 20 °C. Apply this correction factor to the leak rate indicated on the nameplate of the calibration leak. The effective leak rate can be calculated with an accuracy of ± 20 %.

$\geq 10^{-4}$ mbar·l·s^{-1}. As the flow rate of CALIBRATED LEAK TL 6 is between molecular and laminar flow, the correction factor can merely be assessed. Calibrated leak capillaries are manufactured by hand as single pieces and have varying lengths and diameters and hence varying flow profiles affecting the conversion factor.

CALIBRATED LEAK TL 4

For CALIBRATED LEAK TL 4, the correction factor can be determined with sufficient accuracy from the ratio of the viscosity of helium to that of the other search gas to be used.

$$K = \frac{Q_{Gas\ x}}{Q_{He}} = \frac{\eta_{He}}{\eta_{Gas\ x}}$$ η : dyn.-Viscosity

Care must be taken that these viscosities are for the same temperature. The dynamic viscosity η in 10^{-6} kg·m^{-1}·s^{-1} (20 °C)**1)** is given for 5 frequently used gases:

	He	CF_2Cl_2	N_2O_2	Ar	H_2
η	1,96	1,32	1,82	2,21	0,88

1) according to Theorie und Praxis der Vakuumtechnik Vieweg-Verlag, 2nd edition.

CALIBRATED LEAK TL 6

As explained above, a correction factor cannot be exactly calculated. Only an approximate correction can be achieved by assessing a factor between those indicated for laminar and for molecular flow The correction factor for the molecular flow range is calculated from the square root of the ratio of the relative molecular masses of helium and the other search gas used.

$$K = \frac{Q_{Gas\ x}}{Q_{He}} = \sqrt{\frac{M_{He}}{M_{Gas\ x}}}$$ M: Molecular masses

For this type of calibrated leak used in pressure leak testing with halogen leak detectors, a correction factor of 35 was determinded, based on the commercially available „baby“ freon cylinders with a pressure of 5.8 bar at 20 °C. Apply this correction factor to the leak rate indicated on the nameplate of the calibration leak. The effective leak rate can be calculated with an accuracy of ± 20 %.

6 Pressure Dependence of the Leak Flow Rate

In addition to the type of flow and the type of gas, the leak flow rate depends on the pressure difference between inlet and outlet of the calibrated leak. The nominal leak rate is given for a pressure of < 1 mbar at the outlet side and 1000 ± 20 mbar at the inlet side. CALIBRATED LEAKS TL 4 and TL 6 used for leak detectors with sampling probe are operated with atmospheric pressure at the outlet side and overpressure of > 1 bar at the inlet side. The necessary correction of the nominal leak rate is made according to the correction diagram on the rear side of the calibrated-leak holder

Example:
leak rate $3.3 \cdot 10^{-4}$ mbar·l·s^{-1}
overpressure 2.5 bar

A correction factor 4 is read from the diagram.
Hence the real leak rate is:
$3.3 \cdot 10^{-4} \cdot 4 = 13.2 \cdot 10^{-4} = 1.32 \cdot 10^{-3}$ mbar·l·s^{-1}.

7 Handling of Calibrated Leaks

Calibrated leaks are delicate instruments and should be carefully handled and protected against shocks. All CALIBRATED LEAKS are equipped with glass capillaries contained in a protective metal tube. Despite the inlet and outlet filters the micropores of the leak may become clogged up by fine dust or humidity. The calibrated leaks should there fore only be stored in a dry and dust-free place. Only dry search gas must be used to operate the CALI B RATED LEAKs TL 4 or TL 6.

8 Spare Parts

See Fig. 2.

	Cat. No.
Rubber bladder (9)	890 11
Hose nozzle (10)	304 00
Filter (3)	390 26 001
Allan key No.5	281 11 103
Overpressure correction diagram	
10^{-4}	447 92346
10^{-6}	447 92347

6 Pressure Dependence of the Leak Flow Rate

In addition to the type of flow and the type of gas, the leak flow rate depends on the pressure difference between inlet and outlet of the calibrated leak. The nominal leak rate is given for a pressure of < 1 mbar at the outlet side and 1000 ± 20 mbar at the inlet side. CALIBRATED LEAKS TL 4 and TL 6 used for leak detectors with sampling probe are operated with atmospheric pressure at the outlet side and overpressure of > 1 bar at the inlet side. The necessary correction of the nominal leak rate is made according to the correction diagram on the rear side of the calibrated-leak holder

Example:
leak rate $3.3 \cdot 10^{-4}$ mbar·l·s^{-1}
overpressure 2.5 bar

A correction factor 4 is read from the diagram.
Hence the real leak rate is:
$3.3 \cdot 10^{-4} \cdot 4 = 13.2 \cdot 10^{-4} = 1.32 \cdot 10^{-3}$ mbar·l·s^{-1}.

7 Handling of Calibrated Leaks

Calibrated leaks are delicate instruments and should be carefully handled and protected against shocks. All CALIBRATED LEAKS are equipped with glass capillaries contained in a protective metal tube. Despite the inlet and outlet filters the micropores of the leak may become clogged up by fine dust or humidity. The calibrated leaks should there fore only be stored in a dry and dust-free place. Only dry search gas must be used to operate the CALI B RATED LEAKs TL 4 or TL 6.

8 Spare Parts

See Fig. 2.

	Cat. No.
Rubber bladder (9)	890 11
Hose nozzle (10)	304 00
Filter (3)	390 26 001
Allan key No.5	281 11 103
Overpressure correction diagram	
10^{-4}	447 92346
10^{-6}	447 92347

GA 10.198/3.02 - 08/00

9

INFICON GmbH, Bonner Strasse 498 (Bayenthal), D-50968 Cologne
Phone: (0221) 347-40 Fax: (0221) 347-41429
www.inficon.com

UNITED STATES TAIWAN JAPAN KOREA SINGAPORE GERMANY FRANCE UNITED KINGDOM HONG KONG
Visit our website for contact information and other sales offices worldwide. **www.inficon.com**

GA 10.198/3.02 - 08/00

INFICON GmbH, Bonner Strasse 498 (Bayenthal), D-50968 Cologne
Phone: (0221) 347-40 Fax: (0221) 347-41429
www.inficon.com

UNITED STATES TAIWAN JAPAN KOREA SINGAPORE GERMANY FRANCE UNITED KINGDOM HONG KONG
Visit our website for contact information and other sales offices worldwide. **www.inficon.com**

lin a81 e1-a (0008) ©08/2000 INFICON Inc. Printed in Germany on chlorine-free bleached paper

GA 10.198/3.02 - 08/00