WÖHLER

Pressure Computer Wöhler DC 2000PRO

Contents

2015-03-03 Art.-Nr.: 20295

The Measure of Technology

1. Specifications

1.1 Important information

Before using this instrument, carefully read and observe all notes contained in these operating instructions.

Fundamentally, skilled personnel only should use the Wöhler DC 2000PRO for the purpose that it is intended and within the specified data range. No liability is accepted under any circumstances or guarantee given for results determined in conjunction with this instrument nor for any damage that may arise when using this instrument.

The pressure meter can be used on both gaseous media (air or inert gas) and liquids, e.g. water or fuel oil. In this case, it is important to observe that remains of liquid at the pressure connections can falsify the result of the following gas measurement. Therefore, the device should no longer be used on gaseous media, after it has been used to measure liquids.

1. 2 Application

The Pressure Computer DC 2000PRO is a high-precision multifunctional meter for registering differential pressures, flow rates, temperatures, and humidities (optional). From the basic version on, this device exhibits an extremely wide dynamic range that not only takes highly sensitive measurements of minimum draughts and gas pressures in the pascal range, but also lets the user measure leakage rates and examine sealing properties for main assessments as per DVGW-TRGI and conduct measurements for load tests during pre-assessments. A maximum measuring range of 2 bar and a rupture pressure of 3 bar also provide for adequate safety at higher pressure ranges. During all measurements the user is guided by plaintext instructions on the display.
This device, which can store all measured values in a logger, can also be used for measurements of (ambient) climates. This is made possible by a temperature sensor also integrated as standard in addition to the pressure sensor. Optionally, the range of applications can be expanded with an external temperature sensor. Depending on the selected scan rate, all measured values can be logged for several years and transferred to a PC via the integrated IrDA interface. Measurement records can be sent to a thermal printer for printouts with the company logo. If needed, continuous IrDA transfer can be activated in the Setup menu so that during measurements all four measured values (pressure, external and internal temperature, and humidity) and their respective channel numbers are transferred to a PC every second.
The extremely low current consumption is made possible by an all-new processor technology that automatically and dynamically adapts the power draw to the measuring task. Also the mode with the maximum current consumption (6 mA) runs continuously for over 300 hours on two standard AA batteries (2 Ah). In logger mode the device can run on the same batteries and without memory overflow for several years when the scan rate between two measurements is 4 h (4680 measurements x 4 h). The pressure meter can be used on both gaseous media (air or inert gas) and liquids, e.g. water or fuel oil. In this case, it is important to observe that remains of liquid at the pressure connections can falsify the result of the following gas measurement. Therefore, the device should no longer be used on gaseous media, after it has been used to measure liquids.
The processor's arithmetic and logic unit (ALU) can perform simple operations on the measured values so that, for example, the leakage rate is automatically displayed in l/h or the flow rate measured with a Prandtl's tube in m/s.

The German association for safety inspections on gas leak meters, TÜV SÜD Industrie Service zur Gasleckmengenmessung has certified and approved the DC 2000PRO in accordance with the new DVGW requirements under VP 952 for low-pressure gas lines complying with DVGW worksheets G 600 and G 624. (DVGW-Certificate DG-4805BQ0012)

1.3 Measured values

Differential pressure measurements (temperature-compensated piezo bridge)
Measuring range: ±2 bar
1 Pa resolution in measuring range -125.00 hPa to +125.00 hPa, otherwise 10 Pa
Precision: < 3% of measured value, better than ±6 Pa within a range of ±200 Pa.

Internal temperature measurements (NTC)
Measuring range: -20 °C to 60 °C
Precision: < ±2 °C
Resolution: 0.1 °C

External temperature measurements (optional, air temperature sensor order no. 9605 or air temperature probe order no. 9611)
Measuring range: -19.9 °C to +99.9 °C
Precision: < ±2 °C
Resolution: 0.1 °C
T98: < 120 s at 1.5 m/s

Humidity measurements (optional, order no.: 7203)
Measuring range: 0% to 100% RH (relative humidity), non-condensing
Precision: < ±2% RH, within a range of 0–90% RH, otherwise < 3% RH
Resolution: 1% RH

1.4 Calculated values

Pressure units – conversion to **mbar**, **hPa, Pa, mm·$H_2$0, PSI** in accordance with generally applicable conversion rules
Temperature units – conversion from **°C** to **°F** in accordance with generally applicable conversion rules
Flow rates – Prandtl measurements displayed in **m/s**, automatic continuous density correction based on temperature signal
Range: 2–150 m/s
Pipeline volumes automatically from 0.0 to 1000.0 l (tested to 250.0 l)
Leakage rate (0.0 to 300.0 l/h) – l/h in accordance with DVGW-TRG worksheet G 624. The physical data needed to convert diverse gas types can be extracted from a database stored in the device.
Pressure drop – pre-assessments and main assessments in accordance with DVGW-TRGI worksheet G 600

Statistical characteristics – minimum, average, maximum of all measured and calculated values in the respective measurement units
Date and time – output to measurement records.

1.3 Logger mode

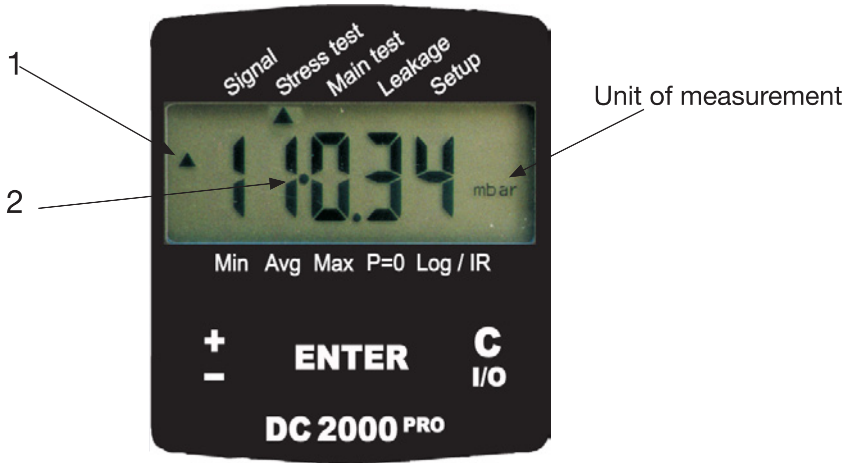
Scope – 4680 measurements each with measured pressure and humidity values and two measured temperature values (when external sensor attached), i.e. max 18,720 measured values
These measured values can be stored in memory **for over ten years**, even without batteries.
IrDA data transfer, also while data are being registered
User-selectable scan intervals – 30 s, 1 min, 3 min, 10 min, 30 min, 1 h, 3 h, 4 h
Control on undervoltage

1.4 Technical data

Current consumption from two AA or dry batteries:
– operating mode: approx. 6 mA
– OFF and logger modes: approx. 16 µA for clock and processor
Interfaces
– infrared data transfer to PC
– in situ printout on thermal printer order no. 9130
Storage temperature – -20 °C to +60 °C
Operating temperature – -5 °C to +60 °C in logger mode (excl. display); incl. display 0–50 °C
Mass – approx. 450 g with protective bag and magnet excl. hose
Dimensions – 54 x 165 x 52 mm

2. Controls and connections

Figure 1 below shows the indicators and controls on the DC 2000^{PRO}. The display always shows the trend ▼▲on the left, the numerical value in the middle, and the corresponding unit of measurement on the right. When a key is pressed, a cursor ▲ appears in addition at the edge of the display to mark the subprogram near the display label. **This menu is activated when the cursor flashes.**
The functions assigned to the keys resemble those on a mobile phone. In general, the **± key** on the left increments or decrements an entered value or displaces to the left or right the cursor ▲ (1) at the edge of the display (see Figure). A short double tap on the **± key** switches from increment to decrement mode or reverses the cursor's movements. This toggle function is indicated by a dot at the centre of the display (2). A second double tap switches back to increment mode or restores the cursor's original direction.
Example: Pressing the **± key** moves the cursor from its position 1 ("Pre-



assessment") to "Main assessment" on the right. The cursor is returned to "Pre-assessment" when the key is first double- then single-tapped (see 2, the dot "•" indicates active reverse mode).

Figure 2.1 - Display and controls on the DC 2000PRO

The **ENTER** key at the centre of the control panel confirms the entered value or activates the program selected at the cursor position.

The right **C I/O key** has two functions. Pressing it once cancels the current menu option or an incorrectly entered value. Keeping it pressed switches OFF the device after about three seconds.

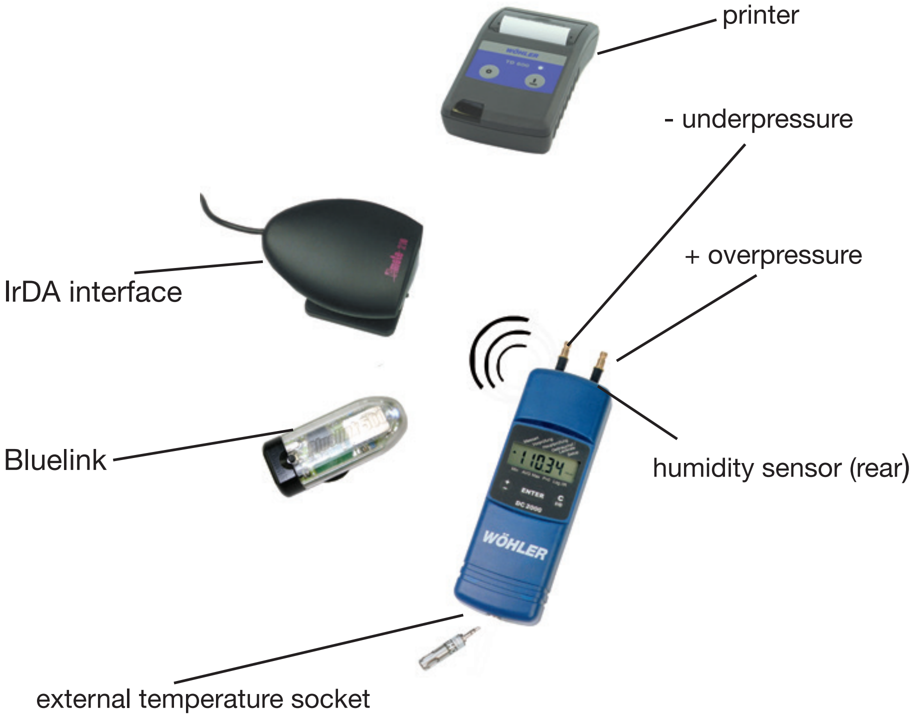


Figure 2.2 – Connections and sockets on the DC 2000PRO Pressure Computer

The socket can take a hose with an internal diameter of 5–6 mm or, if the design of the DC 2000PRO allows this, a DN 2.7-type rapid-action coupling. Silicone hoses can perforate at overpressures greater than 1 bar, adding to the leakage rate, so should not be used for these pressure ranges.
In Figure 2.2, the rear of the DC 2000PRO exhibits diffusion apertures for the internal registration of **ambient humidity** (optional) and **temperature**. The integrated temperature measurement also serves to compensate for temperatures in the pressure sensor. When the device is used as a precision temperature sensor with extended measuring range (–19.9 °C to +99.9 °C) the external combustion air temperature sensor A 500 (order no. 9605) or the external combustion air probe A 500 (order no. 9611) with a 2 m cable can be used. The measured data are read out of the logger and transferred to a PC via the IR (infrared) interface (order no. 9631 serial or 9318 USB or Bluelink 500.)

3. Signal menu

Before the device is used, a visual check must ensure each and every time that all functions work properly. When the device is then switched ON it conducts a self-test. Afterwards the time and date are output. When the device's logger mode has been activated, the text "Log" followed by the current measured and stored values appears instead of the self-test – the device then switches back OFF. For as long as a **flashing cursor** points to the subprogram P=0, no hose should be attached and no differential pressure applied: **during this phase the device is stabilising and determining its zero point.**

The subsections under this heading describe the basic functions in the **Signal** menu item. Pressing the **± key** three times moves the cursor to the subprogram **Signal** which is activated at the ENTER key (cursor flashes under Measuring Mode; see Figure 3.1).

Figure 3.1 – Selecting the Signal menu

3.1 Pressure measurements

The subprogram **Signal** is activated at the ENTER key. The cursor then flashes and the text "PRESSURE" appears on the display together with the unit of measurement "mbar". Now all of the available units can be selected in turn with the ± key and activated at the ENTER key. In this manner the user can select one of the following five units for the pressure measurement: **Pa, hPa, mbar, mm·H20, PSI.**

3.1.1 Fast pressure measurements (regulator test)

The unit of measurement **hPa** features in addition under the name **"Fast pressure"** a pressure measurement with instantaneous display. This mode is particularly suitable for gas regulator tests. The measuring process can be stopped at the ENTER key, and the device displays the last pressure value measured. This state is complemented by the trend symbols v ^. The ± key initiates a single new measurement. Pressing the ENTER key again returns to fast measuring mode. This can be ended with the C I/O key. The device returns to the normal (battery-saving) measuring mode with the unit chosen last.

Signal AUTO alternately displays pressure, temperature, and air humidity values in the pressure and temperature units chosen last.
An overpressure at the socket marked with the **+ sign** and an underpressure at the socket marked with the **– sign** causes a positive differential pressure to be displayed. When the differential pressure exceeds 125 hPa, the device automatically switches to the higher measuring range up to 2000.0 hPa. When the value falls below 125 hPa in this measuring range, the display switches back to a resolution of 1 Pa.

3.2 Flow rate measurements based on Prandtl

The flow rate of air in m/s can be measured with a Prandtl's tube. This measurement is activated when the ± key is repeatedly pressed in the **Measuring Mode** menu until the text "Prandtl" appears with the unit of measurement "m/s". The total pressure of the tube is connected to the + overpressure socket and the static pressure to the – underpressure socket on the DC 2000PRO (see Figure 3.2).
First of all the device must be "zeroed" in a medium at rest (*P=0*). Then the probe is inserted into the gas or air flow, as parallel as possible and with the tip facing the flow, and the measured values are read off. The current flow rate v is automatically calculated with Equation (1). According to Equation (2) the air density ρ in Equation (1) depends in turn on the absolute air pressure p_{cur} and the current temperature *T*.

$$v = \sqrt{\frac{2 \times \Delta p}{\rho}} \qquad (1)$$

$$\rho = 1{,}2 \cdot \text{kg/m}^3 \cdot \frac{293\text{ K} \cdot p_{akt}\text{(hPa)}}{(T(°C) + 273\text{ K}) \cdot 1013\text{ hPa}} \qquad (2)$$

whereby:
v flow rate in m/s
Δp differential pressure in Pa, measured with the Prandtl's tube
ρ air density in kg/m3
p_{cur} absolute air pressure in hPa, manual entry in the Setup menu item (default 1013 hPa)
T air temperature in °C

The absolute air pressure p_{cur} can be set under the menu item **Setup > Absolute pressure.** This setting is also used to determine leakage rates under Section 6.

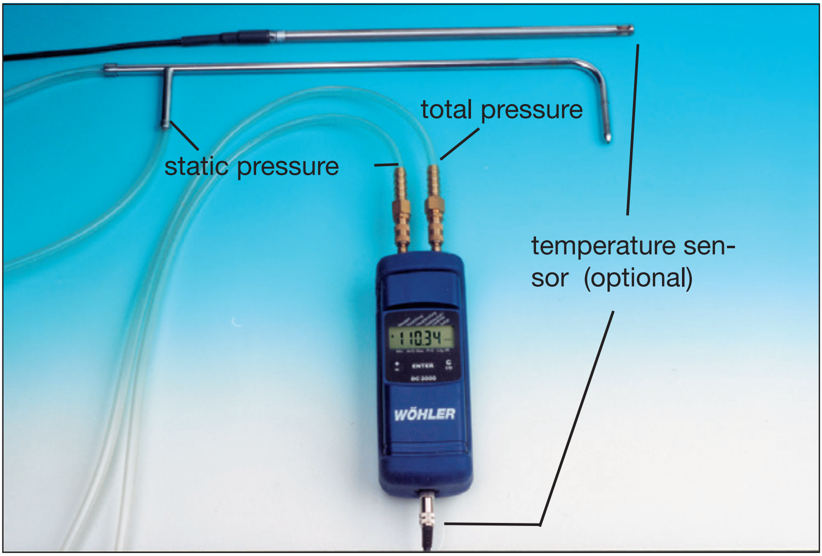


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Figure 3.2 – Prandtl's tube order no. 9487 with combustion air temperature probe A 500 order no. 9611 for automatic density correction

When the temperature T of the measured air flow deviates from the ambient temperature of the DC 2000, the combustion air temperature probe can be inserted over its 2 m cable into the flow parallel to the Prandtl's tube. There is then an automatic follow-up of the air density ρ as a function of the measured temperature T according to Equation (2).

3.3 Temperature measurements

Temperature measurements are activated when the ± key in the **Signal** menu is repeatedly pressed until the text "Temperature" appears with the unit of measurement "°C". Again pressing the ± key switches to the unit of measurement "°F". The ENTER key confirms the selected measuring mode and returns to the display.
An external temperature sensor can be connected at any time. In this case the device switches automatically to the external sensor.
For precision measurements, the sensor's five-digit calibration number (e.g. cal. no. 10208) should be entered under **TLOff** in the **Setup** menu. This calibration number is printed on a metal foil provided with every temperature sensor. When no external sensor is connected, the temperature of an internal sensor is displayed that also serves to compensate for the temperature of the pressure and the optional humidity sensor signals. When therefore ambient

temperatures and humidities are constantly measured the housing should not be exposed to direct sunlight or heat radiation.

3.4 Humidity measurements

Humidity measurements are activated when the ± key in the **Singal** menu is repeatedly pressed until the text “Humidity” appears with the unit of measurement “%”. The ENTER key confirms the selected measuring mode and returns to the display. The diffusion aperture on the rear of the housing should not be obstructed. The humidity sensor is a laser-trimmed, capacitive sensor element with chip-integrated signal processing. It can be retrofitted or replaced by the user as well (order no. 7203) after the two calibration values Zero offset (here 0.833 V, Figure 6) and Slope (here 31.31 mV) have been entered under the Setup menu.

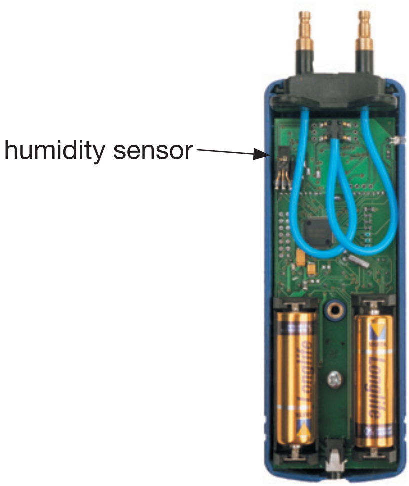


Figure 3.3 – Position of the humidity sensor when the battery compartment cover is removed.

The slope value taken from the provided calibration record must be rounded off to two decimal places (here 31.311 mV —> 31.31 mV).

```
Model: IH-3610-1                  Channel:  81          File: 01072306
Wafer: thunder2                   MRP: thunder2

HYCAL Sensing Products            Linear output for 2% RH accy @25C:
Honeywell Opto.                   Zero offset = 0.833 V
840 Hawkins Blvd. Suite A-3       Slope = 31.311 mV / %RH
El Paso TX 79915                  RH = (Vout - 0.833) / 0.0313
Calculated values at 5V:          Ratiometric response for 0 to 100%RH:
Vout @0%=0.833  @75.3%=3.190      Vout = Vsupply * (0.1665 to 0.7927)
```

Figure 3.4 – Calibration record for a humidity sensor

3.5 Automatically alternating display

The program item **Measuring Mode AUTO** causes the display to alternate between pressure, temperature, and air humidity values in the pressure and temperature units chosen last.

4. Stress test (DVGW-TRGI)

Lines with operating pressures up to 100 hPa can be pre-assessed in accordance with DVGW-TRGI worksheet G 600 and the findings documented very easily with the DC 2000PRO.

Fig. 4.1

First of all, the line must be sealed and a suitable test plug inserted. The DC 2000PRO must be switched ON before it is connected to the test plug. After zeroing, press the ± key to activate the menu item **stress test**.
The DC 2000PRO prompts you to pump to the test pressure (e.g. 1 bar or 1,000 hPa). When the over- and underpressure lines have been swapped over by accident, the text “Swap” appears on the display. When the pressure reaches the preset test pressure the stabilising phase is initiated (default Stab. time = ten minutes). This is marked with the trend symbols ▼▲ . When the pressure remains within ±10% of the test pressure during this stabilisation phase the actual pressure loss test is started at the end of the stabilisation time (default Time = ten minutes). During the stabilisation phase the pressure loss test can also be initiated manually at the ENTER key. The remaining test time and the current pressure values are displayed alternately. When the test time has

ended or been cancelled with the C I/O key the cursor flashes at Pre-assessment on the display and the results can be viewed in turn at each press of the **± key** as follows:

Difference: 54.4 hPa
± key
Start pressure: 1000.3 hPa
± key
Time: 10.00
± key
Stop pressure: 945.9 hPa
± key
Text: “Print …” (activate the printout with the ENTER key)
± key
Difference: 54.4 hPa
etc.

These results can also be printed out or transferred to a PC at a later time under the menu item Print or **Log/IR** respectively. By default, the print-out includes a grafic of the pressure progression. You can disable this function under the item „grafic“.
The record is not deleted until the logger is started or another TRGI test is conducted.

5. Main test menu (DVGW-TRGI)

Lines with operating pressures up to 100 hPa can also be main-assessed in accordance with DVGW-TRGI worksheet G 600 and the findings also documented very easily with the DC 2000PRO.

Fig. 5.1

First of all, the line must be sealed and a suitable test plug inserted. The DC 2000PRO must be switched ON before it is connected to the test plug. After zeroing, press the ± key to activate the menu item Main assessment. The DC 2000PRO prompts you to pump to the test pressure (e.g. 150 hPa). When the over- and underpressure lines have been swapped over by accident, the text “Swap” appears on the display. When the pressure reaches the preset test pressure the stabilising phase is initiated (default Stab. time = ten minutes). This is marked with the trend symbols ▼▲. When the pressure remains within ±10% of the test pressure during this stabilisation phase the actual pressure loss test is started at the end of the stabilisation time (*default Time = ten minutes*). During the stabilisation phase the pressure loss test can also be initiated manually at the ENTER key. The remaining test time and the current pressure values are displayed alternately. When the test time has ended or been cancelled with the C I/O key the cursor flashes at Main test on the display and the results can be viewed in turn at each press of the ± key as follows:

Difference: 17.7 hPa

± key

Start pressure: 110.83 hPa

± key

Time: 10.00 (minutes)

± key

Stop pressure: 93.14 hPa

± key

Text: “Print …” (activate the printout with the ENTER key)

± key

Difference: 17.7 hPa

etc.

These results are stored in the DC 2000^PRO and can also be printed out or transferred to a PC at a later time under the menu item Print or **Log/IR** respectively. The record is not deleted until the logger is started or another TRGI test is conducted.

6. Leakage rates and utility life measurements as per DVGW worksheet G 624

Leakage rates can be determined in accordance with DVGW worksheet G 624 and the findings documented very easily with the DC 2000PRO.

Cursorposition: Utility life/Leakage rate

First of all, the line must be sealed and a suitable test plug inserted (see Section 11). The DC 2000PRO must be switched ON and zeroed before it is connected to the test plug. After the automatic zeroing, press the ± key to activate the menu item Utility life / Leakage rate. The display now shows the text “Pipe volume”. This pipe volume can now be determined either automatically or from a graph.

6.1 Automatically determining pipeline volumes

When the ENTER key is pressed at the same time as the text “Pipe volume” appears, the pipe volume can be determined automatically with the DC 2000PRO. For a pipe volume up to 100 l a syringe takes a sample volume of 100 ml (Figure 6.2 on the left). Lines with volumes greater than 100 l can be tested with a manual test pump (163 ml/stroke, see figure 6.2 on the right). Each test volume must be entered in the DC 2000PRO with the ± key and confirmed with the ENTER key. After a repeated zeroing the DC 2000PRO then shows the text “Pump”. Now the actual sample can be taken with the medical syringe or the manual test pump up to the set volume. The DC 2000PRO then displays automatically the pipe volume calculated with Equation (3). As soon as the display no longer changes this value is confirmed with the ENTER key after which it is used as V_{pipe} for further determinations of leakage rates in accordance with G 624.

The measuring principle

When a known sample volume V_{sample} is taken from a pipeline system (e.g. with a medical syringe or a manual test pump), the total volume V_{pipe} can be determined from the resulting pressure change.

For small pipe volumes a medical syringe proves adequate; for larger pipe volumes a manual test pump can be used. The choice should be such that the pressure change is at least 5 hPa. Boyle's law returns the following equation for the wanted volume V_{pipe}:

$$V_{pipe} = V_{sample} \cdot \left(\frac{p_{akt}}{\Delta p} - 1\right) \quad \text{Temp = const} \qquad \textbf{(3)}$$

whereby:

Vpipe	wanted pipe volume, max 1000.0 l
Vsample	sample volume, default 0.100 l, e.g. with 100 ml medical syringe
Δp	max pressure difference in Pa caused by the taking of the sample
pabs	absolute air pressure, entered manually under the Setup menu

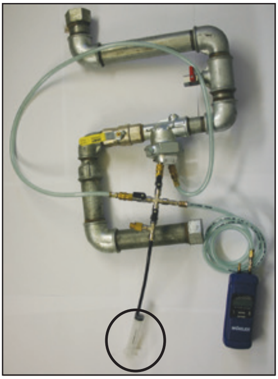



Figure 6.2 – Connections for determining the pipe volume V_{pipe}, with a 100 ml medical syringe (left) or a manual test pump (right)

6.1.1 Determination of the volume of the nozzle

The pressure difference Δp will be measured. It should amount to at least 200 Pa, to get an exact measuring result. Therefore, the volume of the nozzle V_{Sample} must at least amount to 1/500 of the pipe volume. In this case, the expected error of the result of the volume measurement is equal to the inaccuracy of the DC 2000PRO which is 3% of the measured value. A higher pressure will provoque longer stabilization periods during the temperature compensation and possible leakages will have more influences.

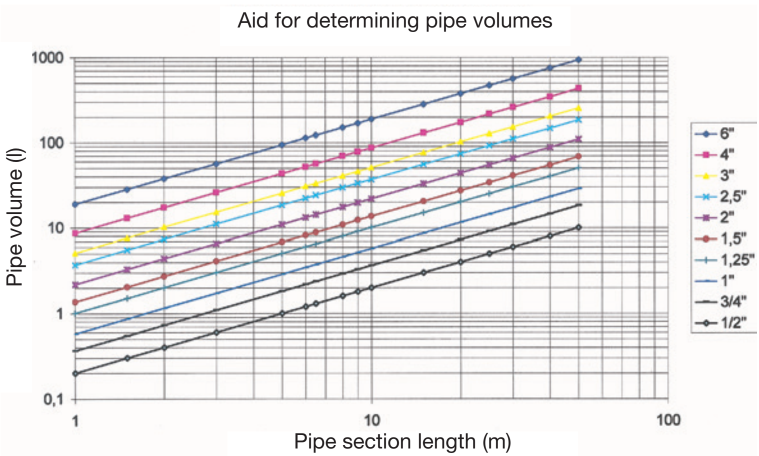
The following table will give you some guiding values for the determination of

Volume of the nozzle	max. pipe volume (DC 2000PRO)
20 ml	10 l
50 ml	25 l
100 ml	50 l
163 ml (1 stroke with the test pump)	80 l
489 ml (3 strokes with the test pump)	240 l

The entire printout for this determination of leakage rate specifies and also documents permanently all interim results for determining the volume. One advantage of this method lies in the insensitiveness to any pipe leaks: the small sample volume leads to pressure differences only of a few hPa in the line. Compared with a usual test pressure of 150 hPa, these low test pressures can scarcely give rise to a perceptible leak.

6.1.2 Determining pipelines from graphs

When the C I/O key is pressed at the same time that the text "Pipe volume" appears, the pipe volume can then be determined from the pipe lengths and pipe diameters in figure 6.3 and entered at the ± key. When this entered value is confirmed with the ENTER key, it is used as V_{pipe} for determining other leakage rates in accordance with G 624. A blow-up of this diagram can be found on the front page of the loose leaf inserted at the centre of these operating



instructions.
Figure 6.3 – Aid for determining pipe capacity

For example, a 1/2" pipe designed with "medium-duty threads in accordance with DIN 2440” of 10 m length has a pipe volume of 2 l.

6.3.3 Determining the leakage rate

Once the pipeline volume has been measured or entered the DC 2000PRO prompts the user to enter the test pressure, the test time, and the operating pressure of the gas line. Afterwards the line is to be pumped to the test pressure (e.g. 100 hPa). To do so, replace now the syringe or the manual test pump with the compressed air pump for applying the test pressure (see Section 11). When the over- and underpressure lines have been swapped over by accident, the text “Swap” appears on the display. When the pressure reaches the preset test pressure the stabilising phase is initiated (default Stab. time = ten minutes). This is marked with the trend symbols ▼▲. When the pressure remains within ±10% of the test pressure during this stabilisation phase the actual pressure loss test is started at the end of the stabilisation time (default Time = ten minutes). During the stabilisation phase, e.g. when the pressure drops greater than 5 hPa, the pressure loss test can also be initiated manually at the ENTER key. The remaining test time and the current pressure values are displayed alternately.

When the test time has ended or been cancelled with the C I/O key, e.g. when the pressure drop is greater than 15 hPa, the cursor flashes at Utility life / Leakage rate on the display and the results can be viewed in turn at each press of the ± key as follows:

Difference: 9.9 hPa
± key
Start pressure: 108.83 hPa
± key
Time: 1 min
± key
Stop pressure: 98.96 hPa
± key
Leakage rate: 8.3 l/h hPa
± key
Text: “Print …” (activate the printout with the ENTER key)
± key
Difference: 9.9 hPa
etc.

The leakage rate is calculated automatically with the following equations (4) and (5) and so complies with the procedure under DVGW-TRGI worksheet G 624:

$$\dot{V}_B = \dot{V}_L \cdot \frac{p_{Bmax}}{p_{Start}} \cdot f \qquad (4)$$

$$\dot{V}_L = \frac{V_{Rohr}}{T_{mess}} \cdot \left[\frac{p_{akt} + p_{Start}}{p_{akt} + p_{Stopp}} - 1 \right] \qquad (5)$$

V_B	gas leakage rate in operating mode in l/h
V_L	air leakage rate at test pressure
p_{Omax}	max operating pressure of the gas in situ
p_{start}	test pressure at start of measurement
p_{end}	test pressure at end of measurement
p_{abs}	absolute air pressure, entered manually under Abs. pressure in the menu Setup (default 1013 hPa)
f	(absolute air viscosity)/(absolute gas viscosity), selection stored in Setup under Gas
T_{meas}	measuring time converted to hours (default 1 min)
V_{pipe}	cubic capacity of the test section in litres (see Figure 7

7. Min, Max, AVG menu

The three cursor positions on the left side of the bottom display edge return the statistical characteristics of all measured and calculated values. The detected minima and maxima and the calculated averages (AVG) can be reset with the P=0 function. The effect of smoothing on calculated averages can be set with the value ALPHA defined in Equation (6). The smaller the value for ALPHA, the greater the effect of smoothing. ALPHA can be varied from 0.01 to 0.99 under the menu item Setup —> ALPHA.

Fig. 7.1

AVG_{new} ALPHA · current measured value + (1 – ALPHA) · AVG_{old}

AVG_{new} mean value at present moment

AVG_{old} mean value one second earlier

Figure 8.1

ALPHA weighting factor for current measured value (0.01–0.99)

8. Setup menu for basic settings and company logo

In the Setup menu a number of settings can be configured. All configurations will be kept after switching off the device or changing the battery.

8.1 Basic configurations

When the Setup menu is open, the ± key can be used to configure a number of settings that are explained in the following. A good overview is also found in the quick reference in the middle of this manual.

1. Setup —> Rounding

Activating this function rounds off the displayed value to a resolution of five digits. For a display in pascals, for example, this means a resolution reduced from 1 to 5 Pa. The result is a considerably more stabilised display under pressure fluctuations, yet without the delay effects usual for averaging. The device continues calculating values based on the higher resolution (ON/OFF, default OFF).

2. Setup —> Medium

This menu selects the gas type and therefore the relative viscosity in Equation (4) (default natural gas).

Gas type	f
natural gas	1.7
air	1.0
town gas	1.3
propane	2.3
butane	2.4
hydrogen	2.0

Table 1 – Relative viscosity of various gases in accordance with Equation (4) based on DVGW-TRGI

3. Setup —> Air pressure

Here you enter the current air pressure pcur in situ (QFE) in hPa for calculating the flow rate with Equation (2) and for determining the leakage rate with Equation (5). This air pressure can range from 800 to 1200 hPa (default 1013 hPa).

4. Setup —> Clock

Here you enter the time and date. When the batteries are removed for no longer than a minute, the clock does not have to be corrected. When the batteries are removed for longer, the clock needs only to be put forward by this time.

5. Setup —> ALPHA

This sets the weighting factor for the averaging function AVG in the form of Equation (6). ALPHA can accept values between 0.01 and 0.99. The lower the value for ALPHA, the less perceptible are the current fluctuations in the signal (see also Section 7; default 0.90).

6. Setup —> Preassessment —> Pressure

Here you can set the test pressure for a pre-assessment (500–1500 hPa, default 1 bar).

7. Setup —> Preassessment —> Time

Here you can set the time for a pre-assessment (1–300 min, default 10 min).

8. Setup —> Main assessment —> Pressure

Here you can set the test pressure for a main assessment (1–500 hPa, default 150 hPa).

9. Setup —> Main assessment —> Time

Here you can set the time for a main assessment (1–300 min, default 10 min).

10. Setup —> Stab. time

Here you can set the time for thermal stabilisation before the start of pre-assessment, main assessment, and the determination of leakage rates. When during this time the current pressure value remains within ±10% of the setpoint pressure, the measurement of the pressure loss starts automatically. The position within this tolerance range and therefore the start of the stabilisation period is marked on the display with the trend symbols v . The measurement of the pressure loss can also be initiated manually at any time at the push of a button (1–300 min, default 10 min).

11. Setup —> TLOff

Here you can enter the calibration number given on the external temperature sensor's label (10000–10300, default 10179).

12. Setup —> Humidity —> Zero offset

Here you can enter the calibration value Zero offset for the humidity sensor. An example zero offset of 0.833 V is given in Figure 6 under Section 3.4 (0.5–1.0 V, default 0.780 V).

13. Setup —> Humidity —> Slope

Here you can enter the calibration value Slope for the humidity sensor. An example slope of 31.31 mV is shown in Figure 6 under Section 3.4. The value taken from the calibration sheet must be rounded to two decimal places (25.00–60.00 mV, default 30.00 V).

14. Setup —> Log rate

Here you can set the time between two registrations by the logger. The default is thirty seconds; in other words, the pressure, two temperatures, and the humidity are each measured and the values written to the integrated data memory every thirty seconds (see Section 9.2; default 30 s).

15. Setup —> AUTO OFF

This activates and deactivates the AUTO OFF function. This serves to switch OFF the device automatically when no key has been pressed for longer than thirty minutes (default ON).

16. Setup —> IrDA

This activates the continuous IrDA data transfer. In this case all four measured values (pressure, 2 x temperature, relative humidity) and their corresponding channel numbers are transferred to a PC every second during the normal measuring process (default OFF).

17. Setup —> Fastprinter

If you enter „OFF“, you can print the dates with the Wöhler TD 23 termoprinter. If you enter „On“, you can print faster with the Wöhler TD 600 termofastprinter (default WÖHLER ON).

18. Setup->Graph ON/OFF
Under this item you can select if a graph of the pressure porcess shall be printed out after the pre-assessment menu, main assesment menu and after the leakage rates and utility life measurements. Default is „on“.

19. Setup —> Logo Here you can enter the logo text for printouts. This is explained under the following Section 8.2 (default WÖHLER MGKG, DC 2000).

20. Setup —> Default This function restores the device’s setup status on delivery. The logo text is overwritten by the original Wöhler logo. All sensor calibration values remain unchanged. Accidental initiation is prevented by the prompt **Sure?**.

8.1 Entering a logo The following Tables 2 and 3 are to assist you in entering a logo into the DC 2000. First enter (preferably with a lead pencil) the text you want in the upper Table 3. The first two rows take twelve characters that are printed in bold. The following rows 4 to 6 can take max twenty-four characters that are printed normally. Finally determine for each row and column the ASCII codes and enter these in the code fields. These values can then be entered and stored row by row under Setup —> Logo. The LOGO converter is also provided in the Excel software that can be downloaded as freeware from the internet address www.woehler.de/mgkg. There the text is converted automatically into ASCII codes.

Table 2 – Conversion example (original logo)

LOGO-Konverter

Texteingabefelder **ACHTUNG!! Leere Zellen sind mit einem Leerzeichen zu füllen** (Zeichensatz: Arial 10)

Zeile/Spalte	1		2		3		4		5		6		7		8		9		10		11		12	
Fett1	W		Ö		II		L		[		R						M		G		K		G	
Fett2					D		C		2		0		0		0									
Spalte	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Normal3	S	c	h	ü	t	z	e	n	s	t	r	.		3	8									
Normal4	3	3	1	8	1		B	a	d		W	u	n	n	e	n	b	e	r	g				
Normal5	I	e	l	.	:	U	2	9	5	3	/	/	3	U										
Normal6	F	a	x	.	:	0	2	9	5	3	/	7	3	8	8									

Code-Ergebnisfelder

Zeile/Spalte	1		2		3		4		5		6		7		8		9		10		11		12	
Fett1	87		214		72		76		69		82		32		32		77		71		75		71	
Fett2	32		32		68		67		50		48		48		48		32		32		32		32	
Spalte	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Normal3	83	99	104	252	116	122	101	110	115	116	114	46	32	51	56	32	32	32	32	32	32	32	32	32
Normal4	51	51	49	56	49	32	66	97	100	32	87	252	110	110	101	110	98	101	114	103	32	32	32	32
Normal5	84	101	108	46	58	48	50	57	53	51	32	55	51	48	32	32	32	32	32	32	32	32	32	32
Normal6	70	97	120	46	58	48	50	57	53	51	32	55	51	56	56	32	32	32	32	32	32	32	32	32

Zeichen		!	"	#	$	%	&	'	(	)	*	+	,		.	/	0	1	2	3	4	5	6	7
Code	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55
Zeichen	8	9	:	;	<	–	>	?	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Code	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79
Zeichen	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	^	_	`	a	b	c	d	e	f	g
Code	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103
Zeichen	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z	{	|	}	~	□
Code	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127

Table 3: Tamplate for own conversions

Texteingabefelder																								
Zeile/Spalte	1		2		3		4		5		6		7		8		9		10		11		12	
Fett1																								
Fett2																								
Spalte	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Normal3																								
Normal4																								
Normal5																								
Normal6																								
Code-Ergebnisfelder																								
Zeile/Spalte	1		2		3		4		5		6		7		8		9		10		11		12	
Fett1																								
Fett2																								
Spalte	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Normal3																								
Normal4																								
Normal5																								
Normal6																								
Zeichen		!	"	#	$	%	&	'	(	)	*	+	,	-	.	/	0	1	2	3	4	5	6	7
Code	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55
Zeichen	8	9	:	;	<	=	>	?	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Code	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79
Zeichen	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	^	_	`	a	b	c	d	e	f	g
Code	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103
Zeichen	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z	{	|	}	~	□
Code	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127

Texteingabefelder																								
Zeile/Spalte	1		2		3		4		5		6		7		8		9		10		11		12	
Fett1																								
Fett2																								
Spalte	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Normal3																								
Normal4																								
Normal5																								
Normal6																								
Code-Ergebnisfelder																								
Zeile/Spalte	1		2		3		4		5		6		7		8		9		10		11		12	
Fett1																								
Fett2																								
Spalte	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Normal3																								
Normal4																								
Normal5																								
Normal6																								
Zeichen		!	"	#	$	%	&	'	(	)	*	+	,	-	.	/	0	1	2	3	4	5	6	7
Code	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55
Zeichen	8	9	:	;	<	=	>	?	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Code	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79
Zeichen	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	^	_	`	a	b	c	d	e	f	g
Code	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103
Zeichen	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z	{	|	}	~	□
Code	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127

9. Logger / data transfer

Fig. 9.1

Fig. 9.2

The menu item Log/IR initiates subprograms that control the long-term data registration (logging) and its infrared output or transfer.

9.1 Data transfer to a PC

The menu item **Log/IR —> IrDA** is used to transfer stored measured values and records to a PC.
The contents stored in the DC 2000PRO are transferred to a PC via the infrared interface (order no. 9631 serial or 9318 USB or Bluelink 500).

Table 4 – Example receive sequence: channel no. + measured value

303025/01/0213:38:19	Start: channel no. 3030 + date and time
3031 107.35	Channel no. 3031 + measured pressure in mbar
3038 22.0	Channel no. 3038 + external temperature in °C
3041 22.0	Channel no. 3041 + internal temperature in °C
3040 40	Channel no. 3040 + relative humidity in %
303025/01/0213:48:19	Stop: channel no. 3030 + date and time

Table 4 shows an excerpt from a transfer sequence read into the Microsoft HyperTerminal program via the IrDA receiver connected to the serial port COM1 (9600, 8, 1, 0, Xon/Xoff). The data from the last measurement record (leakage rates, etc.) are transferred after the measured values. This text file in Table 4 can then be imported into an Excel file where it can be viewed.
The Excel file DC2000.exe can be downloaded as freeware from the internet (http://mgkg.woehler.de). With this programm the logger data can be imported directly in the excel-list and it can also depict the pressure loss measurements in graph form.

9.2 Logging

This menu item starts the logger that can store up to **4680 measurements** each with measured pressure, temperature and (optional) humidity values and two measured temperature values, i.e. max 18,720 measured values. When the battery voltage falls below a threshold of 2 V (battery symbol appears on the display), the logger switches OFF automatically. Before starting the logger for a longer period you should therefore check the battery status under Measuring Mode —> V battery. Even without batteries, measured values are retained in memory for over ten years. When the fastest scan rate of thirty seconds is chosen, values can then be registered for max one day and fifteen hours (see Table 5). The following scan intervals are possible and can be selected in the Setup menu under Setup —> Log rate: 30 s, 1 min, 3 min, 10 min, 30 min, 1 h, 3 h, 4 h.
Table 5: Logger rate and max registration time for 4680 measurements

Log rate	**Max possible measuring time**
30s	39 h
1 min	3.25 days
3 min	9.75 days
10 min	32,5 days
30 min	13 weeks
1 h	27 weeks
3 h	19 months
4 h	approx. 2 years (with good dry batteries)

When the C I/O key is pressed in logger mode the DC 2000PRO only outputs the text “Log” followed by the remaining memory and then the current measured values. The cursor is locked for other commands. Logger mode is ended when the device is switched OFF at the C I/O button (pressed for three seconds). Data are transferred to a PC as explained under Section 9.1.

9.3 Data transfer to a pocket PC

The contents stored in the DC 2000PRO can be transferred with the appropriate software to a pocket PC. This software can be downloaded from the internet
(http:\\mgkg.woehler.de).

9.4 Printing out measurement records

Log/IR —> PRINT – Measurement records can be printed out directly on the TD 600 thermal printer (order no. 4130). When the device is switched OFF the data are retained until they are overwritten by a new pressure loss measurement or logger recordings. The text **Print** appears on the display during the printing process.

10. Changing the batteries

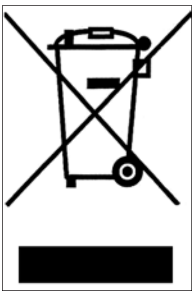
When only the text “**Self-test …” or the message “Change batteries**” appears on the display the batteries are fully depleted.
To replace the batteries remove the rear of the device with a slot-head screwdriver. Now you can replace the batteries (IMPORTANT! Note the polarity!) and screw the rear back on. When the batteries are replaced within one minute the clock does not need to be adjusted. Measured data, settings, and calibration values are retained even without batteries for at least ten years.

Fig. 10.1

11. Accessories

-battery (1.5 V AA)	order no. 2999
-combustion air sensor, plug typ	order no. 9605
-combustion air temperature sensor, 280 mm	order no. 9611
-combustion air temperature sensor, 100mm	order no. 9651
-magnet for securing sensors	order no. 6142
-holding strap with spring hook	ordern no. 9805
-protective bag for meter	order no. 7202
-USB IR interface for PC	order no. 9318
-thermal quickprinter TD 600	order no. 4130
-thermal paper, 10 rolls	order no. 9145
-measuring hose, single	order no. 2338
-measuring hose with brass coupling DN 10	order no. 7209
-retrofit for humidity measurements	order no. 7203
-disposable medical syringe 100 ml	order no. 53196
-manual test pump	order no. 2412
-syringe connecting hose	order no. 30545

12. Information on disposal



You may hand in any defective batteries taken out of the unit to our company as well as to recycling places of public disposal systems or to selling points of new batteries or storage batteries.
In the European Union, electronic equipment does not belong into domestic waste but - in accordance with Directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003 on Waste Electrical and Electronic Equipment - must be disposed of in an expert manner. If you do no longer need this unit, please dispose of it in accordance with the applicable statutory provisions.

13. Declaration of conformity

The manufacturer:	WÖHLER Messgeräte Kehrgeräte GmbH Schützenstr. 38, 33181 Bad Wünnenberg

declares that the product:

product name:	Pressure Computer
model number:	Wöhler DC 2000, version 05 and later
device class:	D, in accordance with VP 952 under DVGW

has been certified and approved by TÜV SÜD Industrie Service zur Gasleckmengenmessung in accordance with the DVGW requirements under VP 952 for low-pressure gas lines complying with DVGW worksheets G 600 and G 624
(DVGW type approval certificate DG-4805BQ0012).

This type approval also included tests by TÜV SÜD Industrie Service zur Gasleckmengenmessung on the device's compliance with the following requirements for conformity and electromagnetic compatibility:

– requirements for electromagnetic compatibility in accordance with EN 61326-1:1997 + A1:1998 + A2:2001
– the requirements under DIN EN 61010-1:2002
– the essential requirements for the protective system in accordance with EN 60529:1991

This declaration is submitted for the above manufacturer by:

Dr Stephan Ester, Managing Director Bad Wünnenberg, 19 October 2004

DVGW CERT

DVGW type examination certificate

DVGW-Baumusterprüfzertifikat

DG-4805BQ0012
Registration Number
Registriernummer

Field of Application *Anwendungsbereich*	products of gas supply *Produkte der Gasversorgung*
Owner of Certificate *Zertifikatinhaber*	WÖHLER Messgeräte Kehrgeräte GmbH Schützenstraße 41, D-33181 Bad Wünnenberg
Distributor *Vertreiber*	WÖHLER Messgeräte Kehrgeräte GmbH Schützenstraße 41, D-33181 Bad Wünnenberg
Product Category *Produktart*	mobile metering appliances: leakage gauge for low pressure gas pipes (4805)
Product Description *Produktbezeichnung*	battery-powered leakage gauge for low pressure gas pipes with digital display
Model *Modell*	DC 2000
Test Reports *Prüfberichte*	laboratory control test: Ü 2029-00/12 from 09.05.2012 (TSG)
Test Basis *Prüfgrundlagen*	DVGW VP 952 (01.07.2004)
Date of Expiry / File No. *Ablaufdatum / Aktenzeichen*	21.01.2017 / 14-0088-GNV

70028-04-A-DE

12.02.2014 Fi/A-1/2
Date, Issued by, Sheet, Head of Certification Body
Datum, Bearbeiter, Blatt, Leiter der Zertifizierungsstelle

DVGW CERT GmbH is an accredited body by DAkkS according to EN 45011:1998 for certification of products for energy and water supply industry.

DVGW CERT GmbH ist von der DAkkS nach DIN EN 45011:1998 akkreditierte Stelle für die Zertifizierung von Produkten der Energie- und Wasserversorgung.

DAkkS
Deutsche Akkreditierungsstelle
D-ZE-16028-01-01

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14. Warranty and service

14.1 Warranty

Every WÖHLER Pressure Computer DC 2000PRO has been subjected to full functional tests and does not leave our production plant until after extensive quality control. The details of the final inspection are set down in an inspection report and stored on our premises. When the device is used for the intended purpose, the warranty period for the device is twelve months following the date of sale. This warranty does not extend to wearing parts (e.g. batteries) or damage to the pressure sensor caused by excess loading.
This warranty does not cover the costs of transport and packaging when the device is sent to us for repairs.
This warranty becomes void when the device is repaired or otherwise modified by unauthorised parties.
We attach great importance to our services not only during the warranty period. We are naturally always there to help you.

- Immediate service work performed directly on our premises when you bring the device to us in Bad Wünnenberg.
- You send us the device, and you will get it back repaired within an average of only five days, delivered by our parcel service.
- You can also obtain immediate help by telephone from our technical personnel.

14.2 Calibration

Although the device has no wearing parts, we recommend an annual inspection by the manufacturer or an authorised service agency.

Points of sale and service

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