Pressure Computer Wöhler DC 2000 PRO

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Quick reference ............ loose leaf at the centre

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 2000\textsuperscript{PRO} 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 2000\textsuperscript{PRO} 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 H₂O, 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
2. Controls and connections

**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 2000\textsuperscript{PRO}

The \textbf{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.

![DC 2000PRO Connections and sockets](image)

**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](image)

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 2000 PRO (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 $\rho$ in Equation (1) depends in turn on the absolute air pressure $p_{\text{cur}}$ and the current temperature $T$.

\[
v = \sqrt{\frac{2 \times \Delta p}{\rho}} \tag{1}
\]

\[
\rho = 1,2 \cdot \text{kg/m}^3 \cdot \frac{293 K \times p_{\text{akt}}(\text{hPa})}{(T({}^\circ\text{C}) + 273 K) \times 1013 \text{ hPa}} \tag{2}
\]

whereby:

- $v$ flow rate in m/s
- $\Delta p$ differential pressure in Pa, measured with the Prandtl’s tube
- $\rho$ air density in kg/m3
- $p_{\text{cur}}$ absolute air pressure in hPa, manual entry in the Setup menu item (default 1013 hPa)
- $T$ air temperature in °C

The absolute air pressure $p_{\text{cur}}$ can be set under the menu item **Setup > Absolute pressure**. This setting is also used to determine leakage rates under Section 6.
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 $\rho$ 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 Signal 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).
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 2000\textsuperscript{PRO}.

First of all, the line must be sealed and a suitable test plug inserted. The DC 2000\textsuperscript{PRO} 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 2000\textsuperscript{PRO} 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-assess-
ment 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.

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

Fig. 5.1
etc.

These results are stored in the DC 2000\textsuperscript{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 2000\textsuperscript{PRO}.

First of all, the line must be sealed and a suitable test plug inserted (see Section 11). The DC 2000\textsuperscript{PRO} 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 2000\textsuperscript{PRO}. 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 2000\textsuperscript{PRO} with the ± key and confirmed with the ENTER key. After a repeated zeroing the DC 2000\textsuperscript{PRO} 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 2000\textsuperscript{PRO} 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 $V_{\text{pipe}}$ for further determinations of leakage rates in accordance with G 624.

The measuring principle

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

For small pipe volumes a medical syringe proves adequate; for larger pipe vo-
lumes 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 \( V_{\text{pipe}} \):

\[
V_{\text{pipe}} = V_{\text{sample}} \cdot \left( \frac{p_{\text{akt}}}{\Delta p} - 1 \right) \quad \text{Temp} = \text{const}
\]

whereby:
- \( V_{\text{pipe}} \) = wanted pipe volume, max 1000.0 l
- \( V_{\text{sample}} \) = sample volume, default 0.100 l, e.g. with 100 ml medical syringe
- \( p \) = max pressure difference in Pa caused by the taking of the sample
- \( p_{\text{abs}} \) = absolute air pressure, entered manually under the Setup menu

Figure 6.2 – Connections for determining the pipe volume \( V_{\text{pipe}} \) 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 \( p \) will be measured. It should amount to at least 200 Pa, to get an exact measuring result. Therefore, the volume of the nozzle \( V_{\text{Sample}} \) 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 2000\textsuperscript{PRO} which is 3% of the measured value. A higher pressure will provoke 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
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 $V_{\text{pipe}}$ 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.

For example, a 1/2“ pipe designed with “medium-duty threads in accordance
6. Determining the leakage rate

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.
6. Determining the leakage rate

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:

\[ V_B = V_L \cdot \frac{p_{\text{Bmax}}}{p_{\text{Start}}} \cdot f \]  \hspace{1cm} (4)

\[ V_L = V_{\text{Rohr}} \cdot \frac{p_{\text{akt}} + p_{\text{Start}}}{p_{\text{akt}} + p_{\text{Stop}}} - 1 \]  \hspace{1cm} (5)

- **\( V_B \)**: gas leakage rate in operating mode in l/h
- **\( V_L \)**: air leakage rate at test pressure
- **\( p_{\text{Bmax}} \)**: max operating pressure of the gas in situ
- **\( p_{\text{Start}} \)**: test pressure at start of measurement
- **\( p_{\text{Stop}} \)**: test pressure at end of measurement
- **\( p_{\text{abs}} \)**: 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
- **\( T_{\text{mess}} \)**: measuring time converted to hours (default 1 min)
- **\( V_{\text{pipe}} \)**: 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.

\[
\text{AVG}_{\text{new}} = \alpha \cdot \text{current measured value} + (1 - \alpha) \cdot \text{AVG}_{\text{old}}
\]

\text{AVG}_{\text{new}} \quad \text{mean value at present moment}

\text{AVG}_{\text{old}} \quad \text{mean value one second earlier}

Fig. 7.1
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).

<table>
<thead>
<tr>
<th>Gas type</th>
<th>f</th>
</tr>
</thead>
<tbody>
<tr>
<td>natural gas</td>
<td>1.7</td>
</tr>
<tr>
<td>air</td>
<td>1.0</td>
</tr>
<tr>
<td>town gas</td>
<td>1.3</td>
</tr>
<tr>
<td>propane</td>
<td>2.3</td>
</tr>
<tr>
<td>butane</td>
<td>2.4</td>
</tr>
<tr>
<td>hydrogen</td>
<td>2.0</td>
</tr>
</tbody>
</table>
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 $p_{cur}$ 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).
8. Setup Menu

18. Setup->Graph ON/OFF
Under this item you can select if a graph of the pressure process shall be printed out after the pre-assessment menu, main assessment 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
Texteinstellfelder | ACHTUNG! Leere Zellen sind mit einem Leerzeichen zu füllen | (Zeichensatz Arial 10)

<table>
<thead>
<tr>
<th>Zeile/Spalte</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
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<th>11</th>
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Code-Ergebnisfelder
Zeile/Spalte | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
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</thead>
<tbody>
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Table 3: Template for own conversions

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<th>Zeile/Spalte</th>
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<th>3</th>
<th>4</th>
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</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Zeichen | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
---|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
Code     | 52 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 |

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 | 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 2000 PRO 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

<table>
<thead>
<tr>
<th>Channel no.</th>
<th>Measured value</th>
</tr>
</thead>
<tbody>
<tr>
<td>3030</td>
<td>25/01/02 13:38:19 Start: channel no. 3030 + date and time</td>
</tr>
<tr>
<td>3031</td>
<td>107.35 Channel no. 3031 + measured pressure in mbar</td>
</tr>
<tr>
<td>3038</td>
<td>22.0 Channel no. 3038 + external temperature in °C</td>
</tr>
<tr>
<td>3041</td>
<td>22.0 Channel no. 3041 + internal temperature in °C</td>
</tr>
<tr>
<td>3040</td>
<td>40 Channel no. 3040 + relative humidity in %</td>
</tr>
<tr>
<td>3030</td>
<td>25/01/02 13:48:19 Stop: channel no. 3030 + date and time</td>
</tr>
</tbody>
</table>
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 program 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**

<table>
<thead>
<tr>
<th>Log rate</th>
<th>Max possible measuring time</th>
</tr>
</thead>
<tbody>
<tr>
<td>30s</td>
<td>39 h</td>
</tr>
<tr>
<td>1 min</td>
<td>3.25 days</td>
</tr>
<tr>
<td>3 min</td>
<td>9.75 days</td>
</tr>
<tr>
<td>10 min</td>
<td>32.5 days</td>
</tr>
<tr>
<td>30 min</td>
<td>13 weeks</td>
</tr>
<tr>
<td>1 h</td>
<td>27 weeks</td>
</tr>
<tr>
<td>3 h</td>
<td>19 months</td>
</tr>
<tr>
<td>4 h</td>
<td>approx. 2 years (with good dry batteries)</td>
</tr>
</tbody>
</table>

When the C I/O key is pressed in logger mode the DC 2000\textsuperscript{PRO} 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 2000 PRO 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](image-url)
11. Accessories

- battery (1.5 V AA) 
  order no. 2999
- combustion air sensor, plug type
  order no. 9605
- combustion air temperature sensor, 280 mm
  order no. 9611
- combustion air temperature sensor, 100 mm
  order no. 9651
- magnet for securing sensors 
  order no. 6142
- holding strap with spring hook 
  order 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 Wün nenberg

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 Gasleck-
mengenmessung 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 Gas-
leckmengenmessung on the device’s compliance with the following require-
ments for conformity and electromagnetic compatibility:

–requirements for electromagnetic compatibility in accordance with EN
–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 Wün nenberg, 19 October 2004
# DVGW type examination certificate

**DVGW-Baumusterprüfungszertifikat**

| Field of Application | products of gas supply  
<table>
<thead>
<tr>
<th>Anwendungsbereich</th>
<th>Produkte der Gasversorgung</th>
</tr>
</thead>
</table>
| Owner of Certificate | WÖHLER Messgeräte Kehrigeräte GmbH  
| Zertifikatinhaber    | Schützenstraße 41, D-33181 Bad Wünnebenberg |
| Distributor          | WÖHLER Messgeräte Kehrigeräte GmbH  
| Vertreiber            | Schützenstraße 41, D-33181 Bad Wünnebenberg |
| Product Category     | mobile metering appliances: leakage gauge for low pressure gas pipes  
| Produktart           | (4805) |
| Product Description  | battery-powered leakage gauge for low pressure gas pipes with digital display  
| Produktbezeichnung   | |
| Model                | DC 2000  
| Modell               | |
| Test Reports         | laboratory control test: Ü 2029-00/12 from 09.05.2012 (TSG)  
| Prüfberichte         | |
| Test Basis           | DVGW VP 952 (01.07.2004)  
| Prüfgrundlagen       | |

**Date of Expiry / File No.**  
21.01.2017 / 14-0088-GNV  
Ablaufdatum / Aktenzeichen

---

**DAkkS**

Deutsche Akkreditierungsstelle  
D-ZE-16028-01-01

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**DVGW CERT GmbH**  
Zertifizierungsstelle  
Josef-Wirmer-Str. 1-3  
53123 Bonn

Tel. +49 222 91 86 - 886
Fax +49 222 91 86 - 993

www.dvgw-cert.com  
info@dvgw-cert.com
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

Germany

Wöhler Messgeräte Kehrgeräte GmbH
Schützenstr. 41
33181 Bad Wünnenberg
Tel.: +49 2953 73-100
Fax: +49 2953 73-96100
info@woehler.de
www.woehler.de

Wöhler West
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44791 Bochum
Tel.: +49 234 516993-0
Fax: +49 234 516993-99
west@woehler.de

Wöhler Süd
Gneisenaustr.12
80992 München
Tel.: +49 89 1589223-0
Fax: +49 89 1589223-99
sued@woehler.de

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Tel.: +1 978 750 9876
Fax: +1 978 750 9799
www.woehlerusa.com

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393 01 Pelhrimov
Tel.: +420 5653 49019
Fax: +420 5653 23078
info@woehler.cz

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Wöhler Italia srl
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39100 Bolzano
Tel.: +390471402422
Fax: +39 0471
www.woehler.it

France
Wöhler France SARL
16 Chemin de Fondeyre
31200 Toulouse
Tel. : 05 61 52 40 39
Fax : 05 62 27 11 31
info@woehler.fr
www.woehler.fr

Your contact: