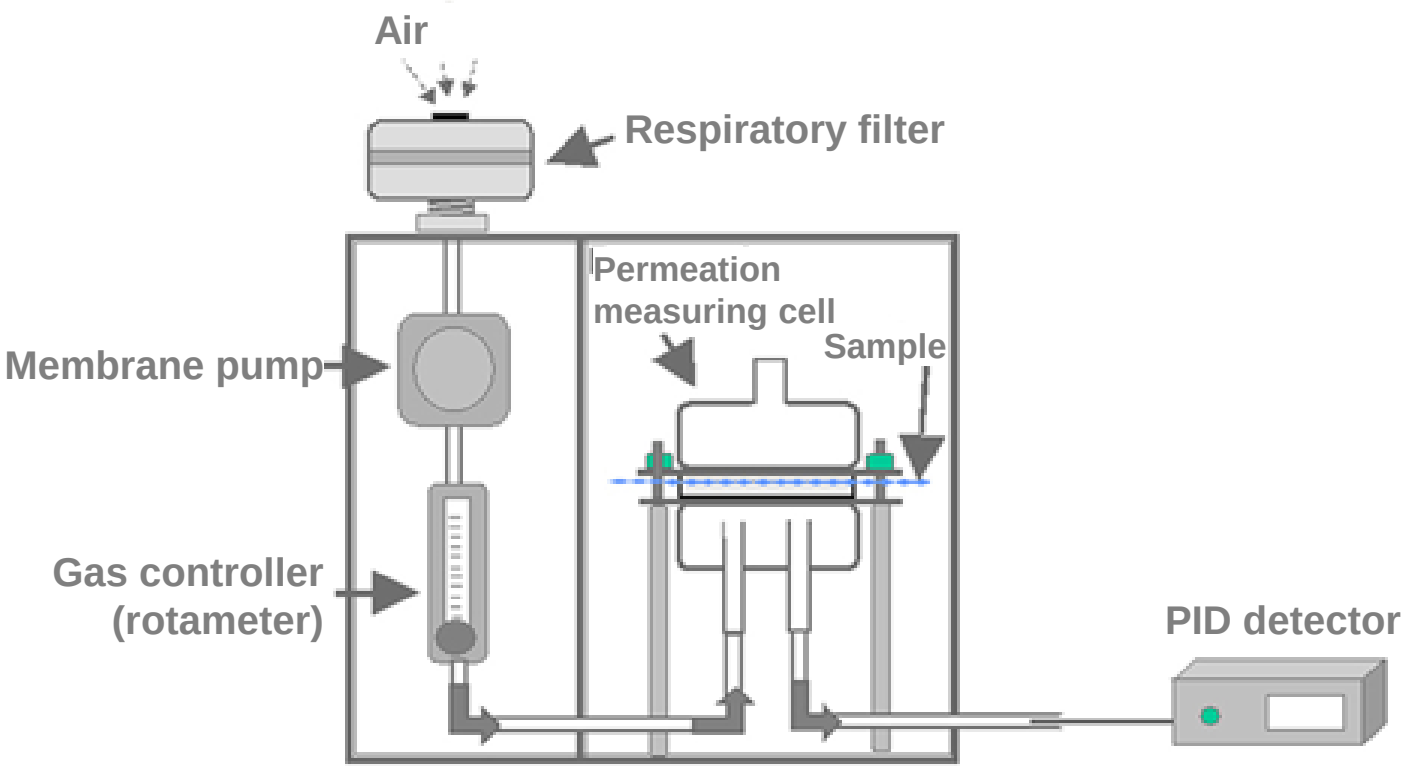
PERMOBIL



LABC

LABORTECHNIK

Instruction manual version 1.5

Edition: October 2015

Contents

PERMOBIL 1. 1_1 Introduction

Mobile permeation test rig (PERMOBIL) in accordance with EN 16523-1 (for 347-3) using the Sirius® PID handheld analyser

(PID = photoionisation detector)

The system described here is used to test the permeability of films (protective gloves, protective clothing) by liquid chemicals that can be detected using a PID detector.

The system is made up of a glass container as described in EN 16523-1 (for 347-3). The liquid to be tested takes effect on one side of the film to be tested. The opposite side is perfused with a specific air flow. The outgoing air flow (collection medium) is suctioned out of an air equalization tank made from glass using the Sirius® PID handheld analyser and analysed in relation to the time. The results are documented in a table. A sharp increase in the PID signal indicates the time after which the film (e.g. protective glove) has reached critical permeation. For quality monitoring purposes during production, a simplified evaluation can be conducted whereas to determine the standard-compliant permeation rate in µg min-1cm-2 (EN 16523-1 (for 347-3)), a laborious calibration process is first required.

PERMOBIL 1. 1_2 Introduction

The workstation ‘PERMOBIL’ no. 717419 for testing the chemical permeation in accordance with EN 16523-1 (for 347-3) for substances that can be detected by a PID comes with:

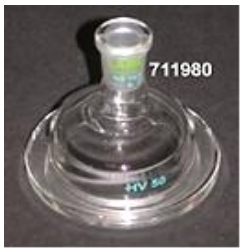
A container made from Plexiglas and aluminium sections that can be carried by its handles and has an integrated temperature control with a fan, a heater (300 W) and a Peltier cooler (>100 W) so as to reach the stipulated EN test temperature of 23°C ± 1°C.
An integrated pump to suction the ambient air through a standard active carbon filter with a volume flow meter and regulator.
Technical data for the PERMOBIL: 230V, weight: 13 kg, dimensions: H = 365 mm, (460 mm with filter!), W = 450 mm, D = 300 - 375 mm
A permeation measuring cell in accordance with EN 16523-1 (for 347-3), including connecting hoses to an air equalization tank made from glass.
A SIRIUS® PID detector prepared for measurements with the PERMOBIL:
- SIRIUS data logging, Ex/Ox, CO, H2S, PID, Li-Ion rechargeable battery
- Li-Ion rechargeable battery module
- Charging adapter with power supply
- Jeteye PC IR adapter with a USB connection
- MSA Link software with IR connection
- 1.5 m sampling hose
- Rubber impact guard and carrying strap.

Series 358 digital mass flow meter for testing the gas flow in the PERMOBIL (EN 16523-1 (for 347-3)) incl. 9V battery pack + network adapter for the 9 V battery pack.
Total weight 18 kg. Customs tariff number: 90278099

PERMOBIL 1. 2_1 Spare parts

No. 717420 PERMOBIL mobile permeation test rig in accordance with EN 16523-1 (for 347-3) incl. permeation measuring cell NW50 No. 711988 with shelves opened to the sides for the PID, scope of delivery and figure: without PID!

No. 711988 Permeation measuring cell NW50 in accordance with EN 16523-1 (for 347-3) for testing PPE films (protective gloves, protective clothes) in relation to the permeability of liquid test substances and gaseous collection media. NW 50 permeation measuring cell made from glass, complete, in bracket with three feet and PTFE clamping device incl. silicon FEP-coated O-ring seals (2 x 56 mm + 1 x 62 mm)



No. 711980 Upper piece for the NW50 permeation measuring cell with NS 14.5 joint collar
No. 711981 Lower piece for the NW50 permeation measuring cell
Gas inlet and outlet hoses for the collection medium air

No. 711982-EN PTFE clamping device in accordance with EN 374-3 for the NW 50 permeation measuring cell for clamping films, protective gloves etc. made from PTFE and 3 x FEP-coated VQM O-rings
No. 711982-ASTM PTFE clamping device in accordance with ASTM1 for NW 50 permeation measuring cell for clamping films, protective gloves etc. made from PTFE and 3 x FEP-coated VQM O-rings

No. 711978-EN O-Ring seal set in accordance with EN 374-3 for the permeation measuring cell comprising
2 x 56 mm + 1 x 62 mm silicon rings/FEP-coated for PTFE clamping device no. 711982-EN
No. 711978-ASTM1 O-Ring seal set in accordance with ASTM 1 (2.54 cm) silicon/FEP-coated for PTFE clamping device no. 711982-ASTM

No. 711987 Bracket for NW50 permeation measuring cell made from moulding material with screws and feet

No. 717428 Air equalization tank in the PERMOBIL made from glass for the collection medium of air

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PERMOBIL 1. 2_2 Spare parts

No. 717421 PTFE hose
iD = 8.0 mm, oD = 10.0 mm
Packaging unit = 2 m

No. 717426 PVC hose, soft, transparent
iD = 8.0 mm, oD = 11.0 mm
Packaging unit = 2 m

No. 717422 Gas filter DIRIN 230 AX-P3 with round thread in accordance with DIN EN 148-1

No. 717423 Glass filling funnel for the NW50 permeation measuring cell, shaft length: approx. 155 mm, funnel Ø: approx. 55 mm

No. 717424 Glass lid (Petri dish)
ID approx. 60 mm for filling funnel

No. 717406 PBT GL 14 screw cap sealed with a PTFE-coated elastomer seal

No. 717431 Hose barb for glass thread GL14 curved with a GL 14 screw cap, packing unit = x 10

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PERMOBIL 1.2_3 Spare parts

No. 718669 SIRIUS® PID detector for PERMOBIL
(in accordance with EN 16523-1 (for 347-3) and ASTM)
- SIRIUS data logging, Ex/Ox, CO, H2S, PID, Li-ion rechargeable battery
- Li-Ion rechargeable battery module
- Charging adapter with 230 V power supply
- Jeteye PC IR adapter with a USB connection
- MSA Link software with IR connection
- 1.5 m sampling hose
- Rubber impact guard and carrying strap.

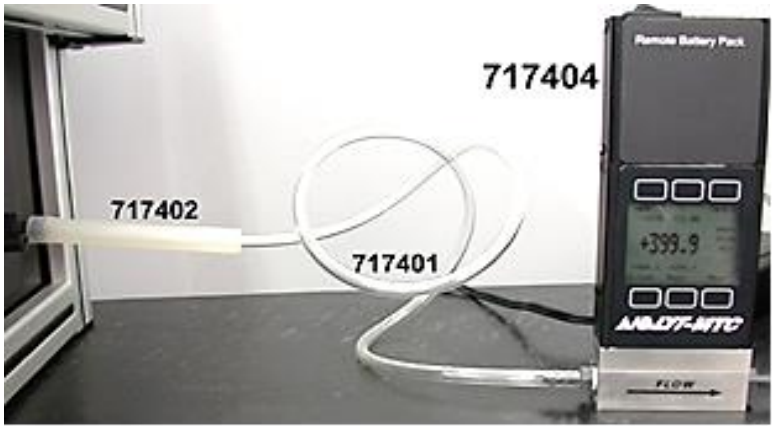
No. 717430 PTFE hose for PID detector
IØ = 2 mm; OØ = 3 mm
Packaging unit = 1.50 m

No. 717403 Spare 10.6 eV PID bulb (green), for SIRIUS®

No. 717404 Series 358 digital mass flow meter for testing the gas flow in the PERMOBIL

No. 717401 PVC hose, transparent
OØ: 6 mm, IØ: 4 mm for connection to the digital mass flow meter
series 358
Packaging unit = 2 m

No. 717402 Silicon vacuum hose, 6 x 12 mm, opaque as connection adapter for PVC hose OØ: 6 mm to PERMOBIL



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Using the PERMOBIL

Device structure

The measurement of the permeation by chemicals is dependent upon the ambient temperature and must, in accordance with standards, be carried out at a temperature of 23 °C (±1 °C). To ensure that this requirement is met even at higher and lower ambient temperatures, the measuring cell in the PERMOBIL is located in a transparent, air-conditioned chamber. The temperature consistency is achieved through a ventilation-controlled combination of heating (300 W) and Peltier cooling (> 100 W).

To prepare the sample, a glass permeation cell in accordance with EN 16523-1 (for 347-3) uses its practical PTFE sample holder to grasp the test sample to be tested. The test substance is applied from above to one side of the horizontally clamped sample (protective glove, protective clothing). The rear half cell of the permeation measuring cell is continually flushed with the collection medium air, which is then fed into an equalization tank. The collection medium air is generated from the ambient air. An integrated diaphragm pump with a downstream rotameter for precise flow regulation suctions the ambient air through a suitable combination multi-use filter. The filters, which were actually designed for use with respirator masks, are screwed into a thread that has been standardised in accordance with DIN EN 148 and can be easily replaced.

From the equalization tank, part of the purge gas (collection medium air) is analysed to determine the level of volatile organic compounds using an external mobile photoionisation detector (Sirius® with PID detector from MSA Auer).

Conducting permeation measurements

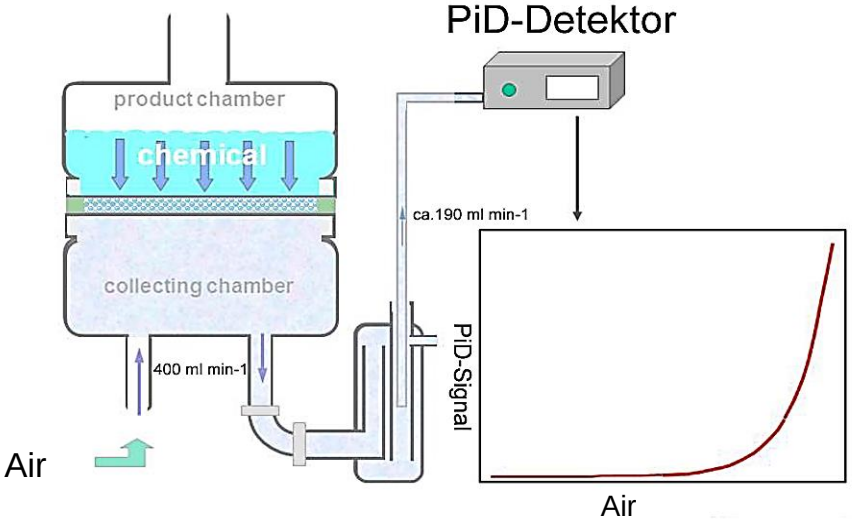
To conduct a permeation measurement in accordance with EN 16523-1 (for 347-3), a piece is cut out of the palm of a glove and stretched out in the cell's sample holder.

400 ml min-1 of purge gas (collection medium air) are permanently fed through the lower half cell of the permeation measuring cell NW50. A flow meter is used to check the purge gas flow at the outlet of the equalization tank before each measurement.

To achieve a constant temperature, the measuring cell in the PERMOBIL is pre-conditioned at a temperature of 23°C (±1°C) for at least 30 minutes.

The test chemical is also brought to a test temperature of 23°C (±1°C).

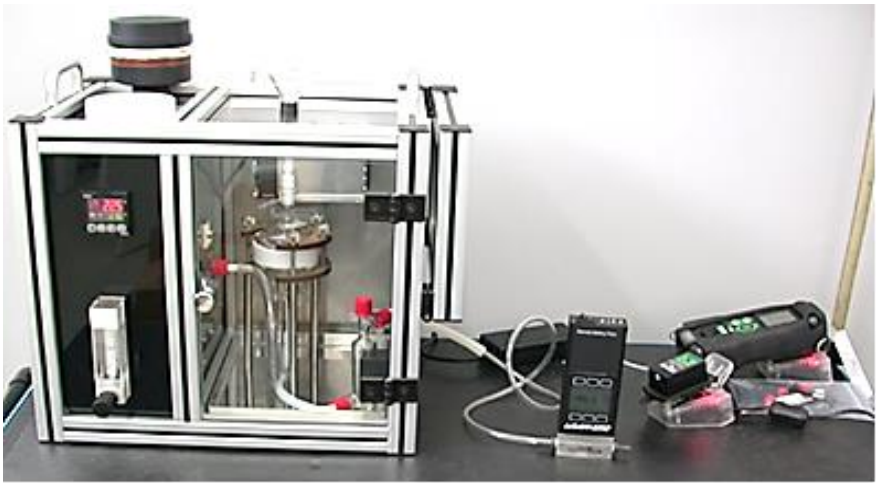
The liquid test chemical is applied to the test sample on one side only and from above, completely filling the half cell. The self-priming (approx. 190 ml/min) mobile PID (Sirius®, MSA Auer) detects the level of volatile organic compounds depending on the time in the equalization tank. To this end, the substances to be tested must be regarded as volatile and detectable by the SIRIUS® PID detector system! An overview table can be found in Section 8 'Technical Data' of the instruction manual for the SIRIUS®, MSA Auer.



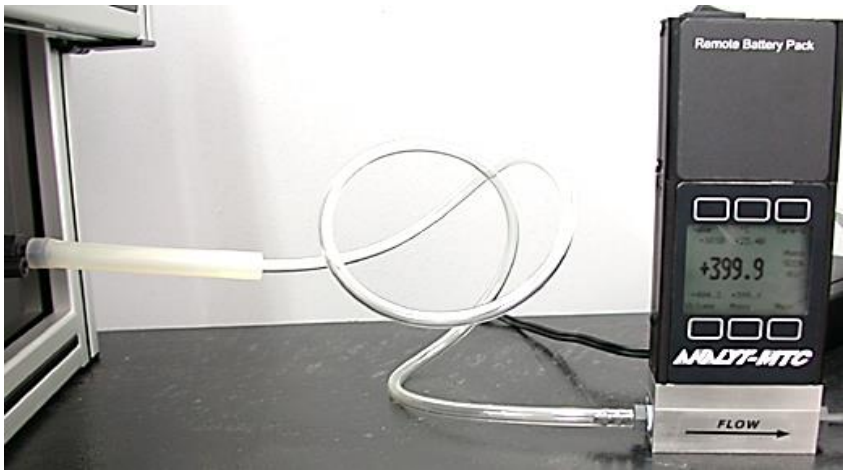
PERMOBIL 1.3_2 Using…

Charge the batteries (Sirius® + flow meter)

Remove the protective filter cap



Switch on the PERMOBIL, PID and flow meter



Use the setting screw on the rotameter to set a gas flow of 400 ml/min and check this using the connected flow meter. Check for leaks!

PERMOBIL 1.3_3 Using…

The temperature automatically sets itself to the necessary test temperature of 23 °C ±1 °C

Roughly cut the protective glove sample

Place the protective glove sample on the lower part of the PTFE clamping device

Clamp the protective glove sample into the bracket

PERMOBIL 1.3_4 Using…

Cut off any excess film

Prepare the permeation measuring cell

Put the PTFE clamping device and the upper part into place

Place on the upper bracket from the moulding material (nut points downwards!) and screw into place with the cross-head screws

PERMOBIL 1.3_5 Using…

Tighten the knurled screws by hand. Do not use a tool due to the risk of breakage

Position the permeation measuring cell at the back right

Tightly (by hand) screw the permeation measuring cell's clear, transparent PVC hose to the air inlet (left!).

Tightly (by hand) screw the milky PTFE hose to the air equalization tank

PERMOBIL 1.3_6 Using…

Connect the filling hose's PTFE joint to the permeation measuring cell's

NS 14 socket

Allow the permeation measuring cell to reach the optimum temperature of 23 °C with the door of the PERMOBIL closed. This should take approx. 30 minutes

Prepare the Sirius PID handheld analyser (MSA Auer)

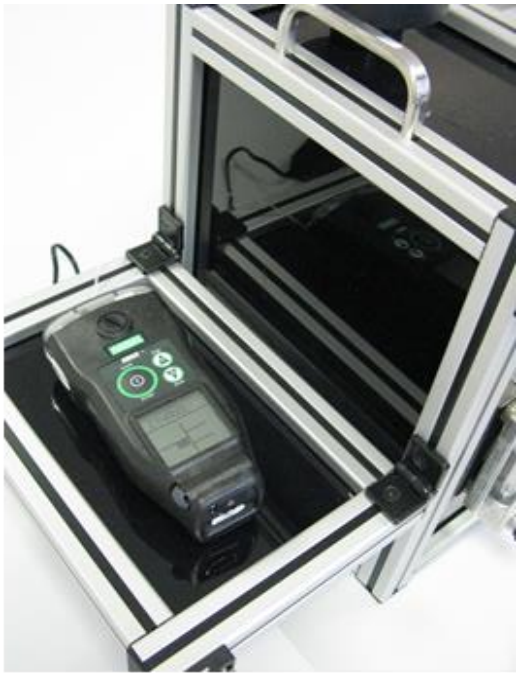
Place the (Sirius®) PID's PTFE suction hose loosely into the flue gas flow,...

PERMOBIL 1.3_7 Using…

... so that it sticks approx. 2-3 mm into the flue gas hose

The air inlet stream is set to 25 on the air controller (lower edge of the ball at the 25 mark!). The carrier gas flow through the lower section of the permeation measuring cell is then 400 ml/min

Use a disposable syringe to inject the sample via the funnel.



Caution! This marks the start of the measurement! Note the time! (This time must be previously compared with the time in the Sirius®!). Seal the funnel with the Petri dish provided.

PERMOBIL 1.3_8 Using…

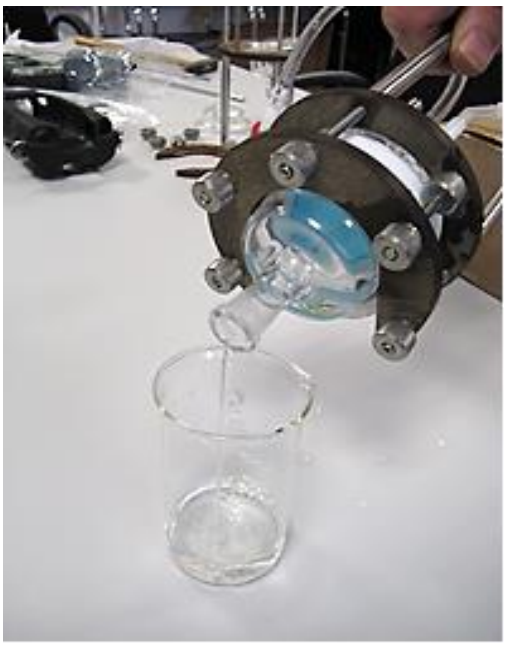
After the measurement, disconnect the filling hose's PTFE joint from the permeation measuring cell's NS 14 socket

Disconnect the PTFE hose connection from the air equalization tank

Disconnect the permeation measuring cell's clear, transparent PVC hose from the air inlet (left!)

Remove the permeation measuring cell from the PERMOBIL

PERMOBIL 1.3_9 Using…



Empty the permeation measuring cell EN 16523-1 (for 347-3)

Completely empty the permeation measuring cell

Disassemble and thoroughly clean the permeation measuring cell (the filling funnel, incl. the hose, must also be cleaned!!!)

Switch off the PERMOBIL and evaluate the PID

a.
When determining permeation rates, the SIRIUS® multi-gas detector's PID is used to measure volatile organic compounds (VOCs) (also see MSA's comprehensive operating manual in Appendix 2).
The MSA PID is characterised by its high zero point stability and quick reaction to VOCs. It is also extremely moisture-resistant. The bulb and ionisation chamber offer easy external access and can be quickly replaced if necessary.
The SIRIUS® PID detector is preconfigured by LABC to enable users to take measurements immediately.
The PTFE suction hose (an integrated pump in the SIRIUS® suctions the gas to be detected at a constant rate of 190 ml/min) is placed loosely in the flue gas flow (see 1.3_6). After the large, round On-Off/ACCEPT button has been pressed and a self-test has been conducted, VOC 0.0 appears on the display. SIRIUS® stores the current reading every 15 seconds.

Tip:
- A 'warm-up phase' of approx. 30 minutes before starting the permeation measurement is recommended
- Before inserting the SIRIUS® PTFE suction hose, the flue gas flow is tested with the built-in film sample: if the rotameter and the flow meter both display 400 ml/min, the test structure is airtight.

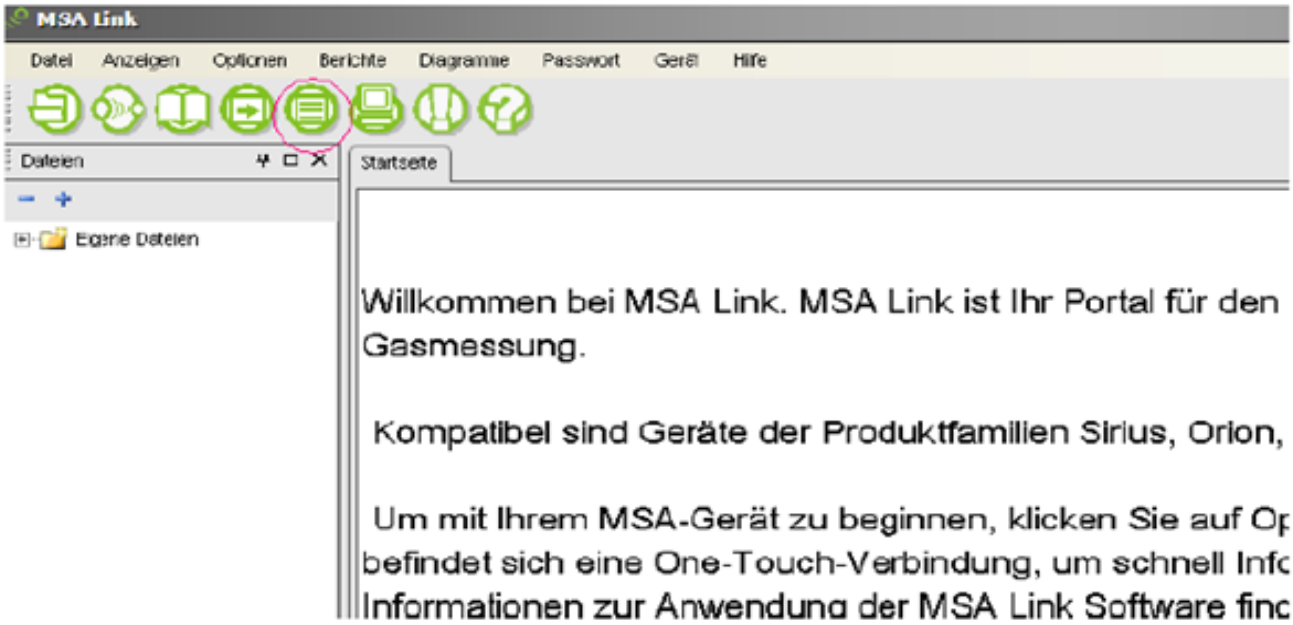
b.
After pressing the 'page' button, the date and time appear. Important! Both must be noted so that the penetration time can be determined once the measurement data has been read. At the same time, approx. 12 ml of the test chemical are quickly applied to the film sample in the permeation measuring cell. The display jumps back to the measurement within 30 seconds.

c.
The measurement is over when the readings become stable again after increasing quickly. The readings are stored in the SIRIUS® every 15 seconds and can be read using a PC immediately or at a later time.

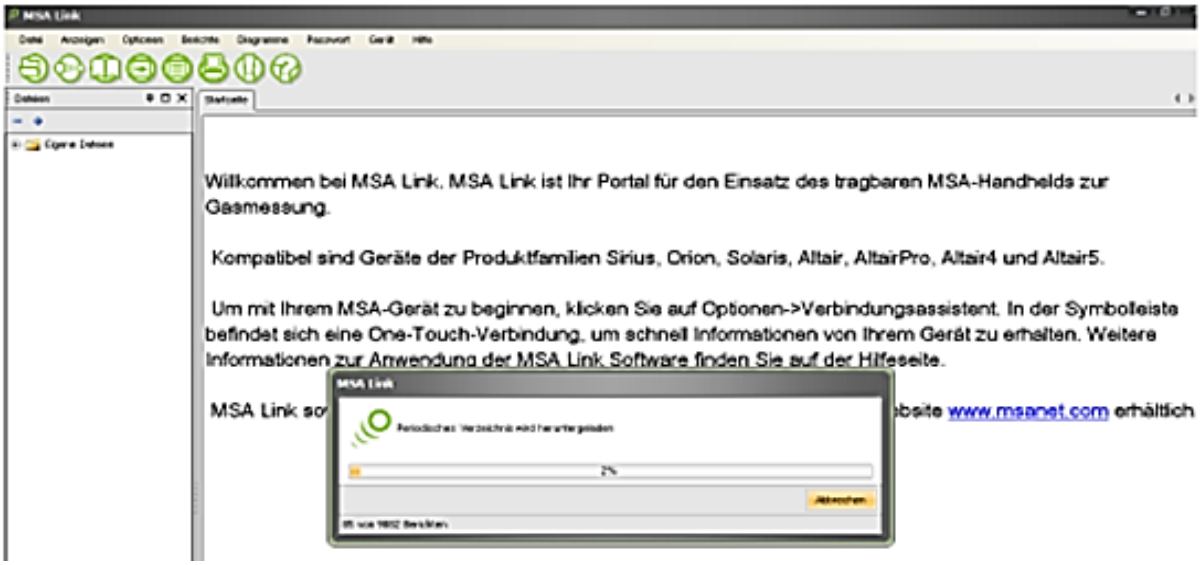
d.
After the measurement, all components that could have come into contact with the test chemical must be cleaned.

PREMOBIL 1.4_1 Reading the measurement data stored in the Sirius®

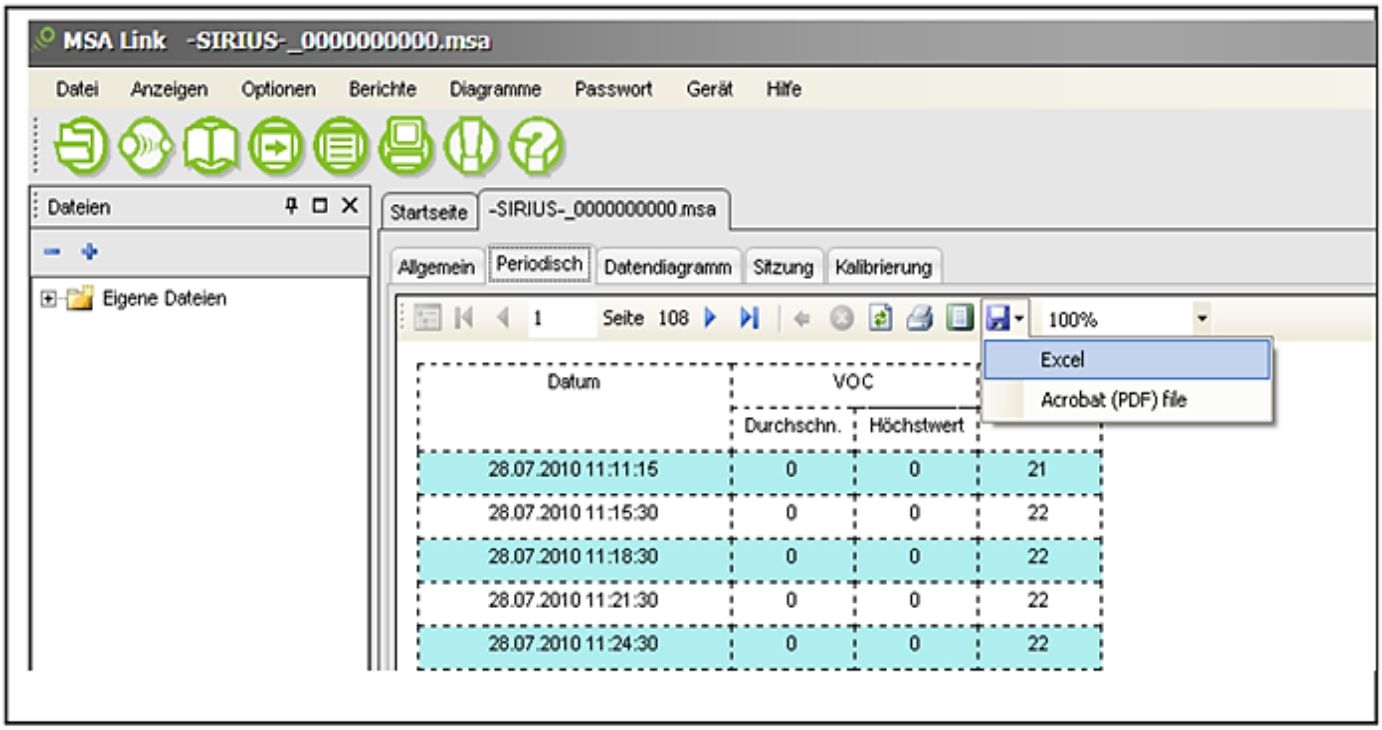
a.
Connect the Jeteye PC IR adapter to the USB, install the program 'MSA Link™' (from the CD provided) and configure the connection options (once only!). Start the program 'MSA Link™', switch on the SIRIUS® and connect it using the IR adapter (see adjacent image!)



b.
Select the calibration. A small window opens and displays the progress of the measurement data download.



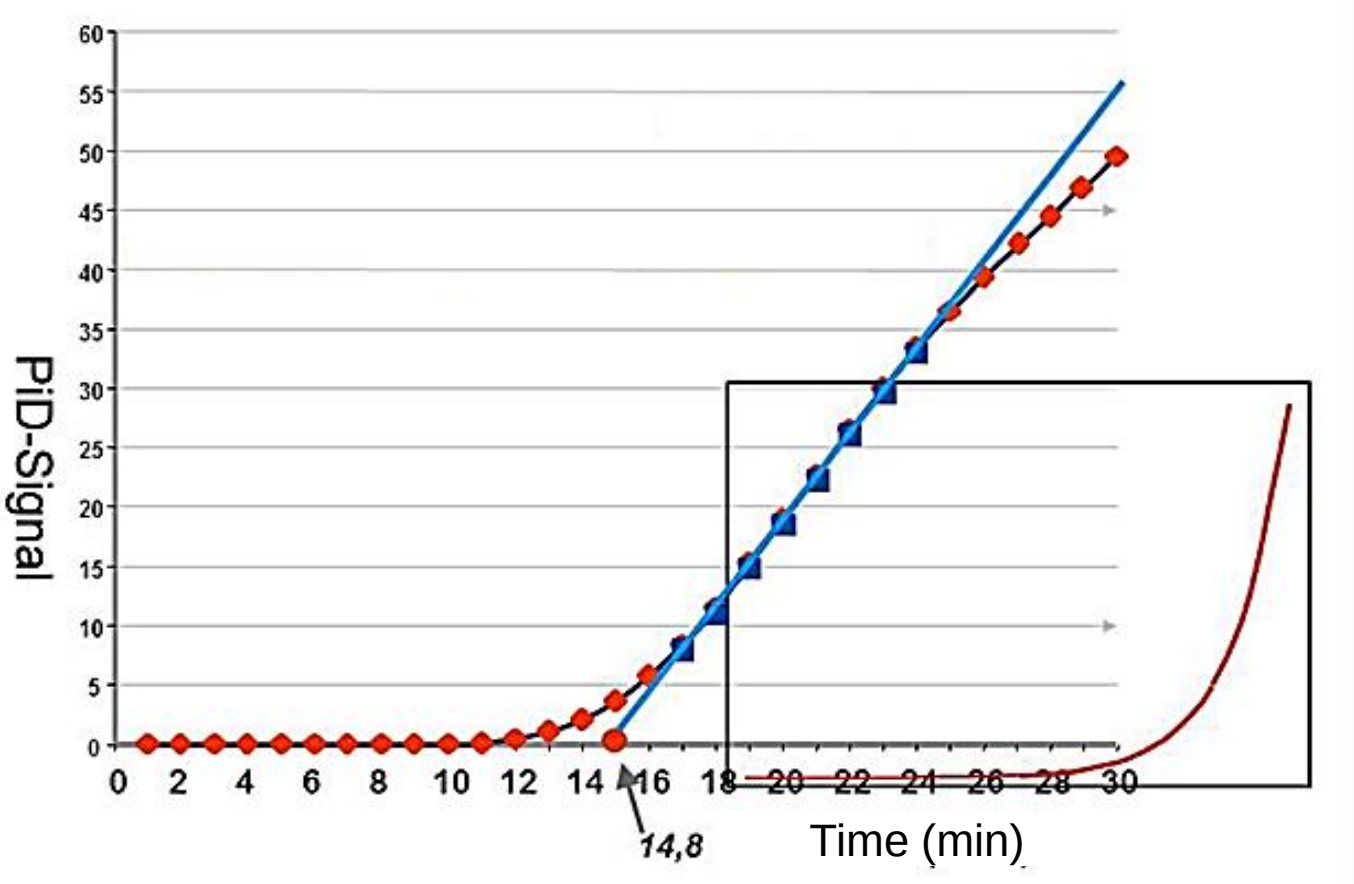
c.
The stored data and settings appear. To store the data and save them in Excel, click ‘periodisch’ (‘periodical’) and Excel.



The data is prepared in Excel using the date and start time that were noted and a graph is created.

PERMOBIL 1.5_1 Evaluating the measurement data

Simplified determination of the penetration time within the scope of quality monitoring when manufacturing PPE. EN 16523-1 (for 347-3)
If the PERMOBIL is solely used to monitor quality in the production department, this laborious standard-compliant calibration process is not necessarily required. In such cases, it suffices to take a measurement from which the permeation curve received is extrapolated in the linear areas. Both the detector signal's zero line and the increase after the penetration of the test substance are extrapolated. If the plumb line lands on the x-axis on the lower intersection of the two straight lines, you receive a reproducible time, which is slightly shorter than the standard-compliant penetration time.
By using this simplified method, a change in the penetration time also shows PPE manufacturers that the material or sample thickness must have changed. As only the relative change to the penetration time is determined, this type of evaluation suffices for users within the scope of quality assurance and also saves time.
Caution! It is important that comparisons are only made between measurements that have been taken with one and same detector. Both different detector types and different detectors in the same series can display different increases in the permeation curve with the same real concentration course.

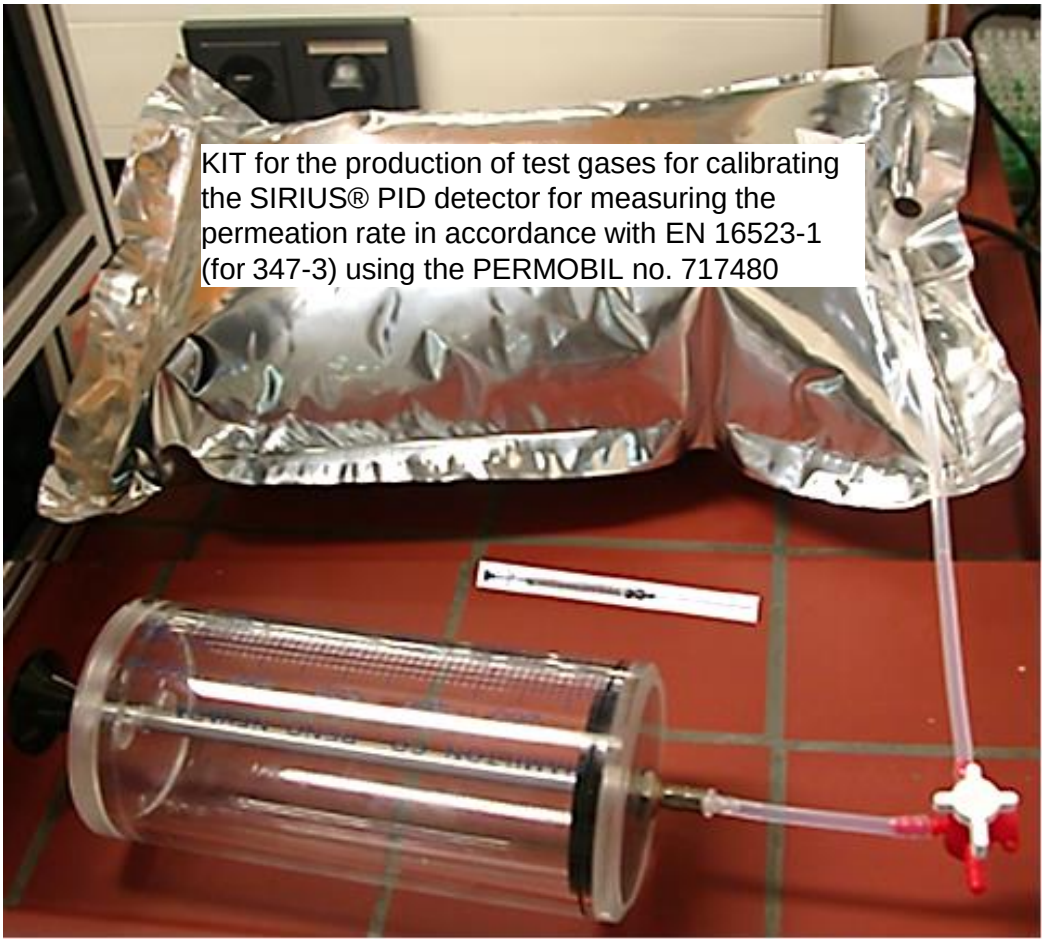


PERMOBIL 1.5_2 Evaluating the measurement data

Standard-compliant determination of the penetration

If a test substance permeates the membrane with a permeation rate of ≥1 µg*min-1*cm-2, penetration exists in accordance with EN 16523-1 (for 347-3). The relevant penetration concentration for the permeation measuring cell is calculated and produced as a test gas. The calibration occurs solely by measuring the test gas with the Sirius® PID (MSA Auer). The detector signal obtained using this method then corresponds to achieving penetration (also see EN 16523-1 (for 347-3)).

KIT for the production of test gases



KIT for the production of test gases for calibrating the SIRIUS® PID detector for measuring the permeation rate in accordance with EN 16523-1 (for 347-3) using the PERMOBIL no. 717480

for calibrating the SIRIUS® PID detector for measuring the permeation rate in accordance with EN 16523-1 (for 347-3) using the PERMOBIL, comprising:

- 10 x 10 litre Tedlar bags with PP fitting and septum
- 1 x 1 µL microliter syringe 7101N, Pst.2, needle: 70 mm, 22S gauge
- 1 x gas-tight Hamilton super syringe, S1000, TLL
- 10 x hose connector, PP, male Luer Lock for TLL /hose barb 5-6 mm
- 10 x hose connector, PP, female Luer Lock, tube-olive 4-5mm
- 1 x 3-way PE valve, red/white, barbs: 5-7 mm
- 5 m hose, PVC transparent, IØ = 4 mm OØ = 7 mm
- 0.05 m silicon hose IØ = 3 mm OØ = 7 mm
- As adapter for PTFE hose from PID with OØ = 3 mm at 3-way stopcock

Product number: 717480

PERMOBIL 1.5_3 Evaluating the measurement data

a.
Formula for calculating the injection amount

$$V(SV) \quad \frac{m\,(standard) * A\,(sample) * V\,(bag)}{Q\,(Permobil) * \delta\,(SV)}$$

V(SV): solvent injection volume [µl]
m(standard): standard threshold [EN 374-3: 1 µg*cm-2*min-1]
A(sample): sample area [cm²]
V(bag): bag gas volume [l]
Q(Permobil): Permobil gas flow [target: 400 ml*min-1]
δ(SV): solvent density *g*cm-3]

Examples of test chemicals

Substance	Sample area [cm²]	Bag volume [dm³]	Gas flow [ml/min]	Density [g*cm-3]	Volume to be injected [µl]
Methanol	20,43	10	400	9	0,647
Acetone	20,43	10	400	0,79	0,647
Acetonitrile	20,43	10	400	0,78	0,655
Dichloromethane	20,43	10	400	1,33	0,384
Carbon disulfide	20,43	10	400	1,26	0,405
Toluene	20,43	10	400	0,87	0,587
Diethylamine	20,43	10	400	0,7	0,730
Tetrahydrofuran	20,43	10	400	0,89	0,574
Ethyl acetate	20,43	10	400	0,899	0,568
n-Heptane	20,43	10	400	0,68	0,751
N-Methylpyrrolidone	20,43	10	400	1,03	0,496
Isopropanol	20,43	10	400	0,78	0,655
Ethanol	20,43	10	400	0,79	0,647
Cyclohexanone	20,43	10	400	0,95	0,538

b.

The Tedlar bag is filled with 10 l of VOC-free air using the 1 l gas-tight Hamilton super syringe S1000. The calculated amount of test chemical is injected into the 10 l Tedlar bag via the septum using the microliter syringe. After a waiting period of at least two hours, the test chemical is fully evaporated. The Tedlar bag is then connected to the SIRIUS® PID and a measurement is taken. The value displayed corresponds to the permeation rate of ≥ 1 µg*min-1 *cm-2 (in accordance with EN 16523-1 (for 347-3) of the penetration concentration.

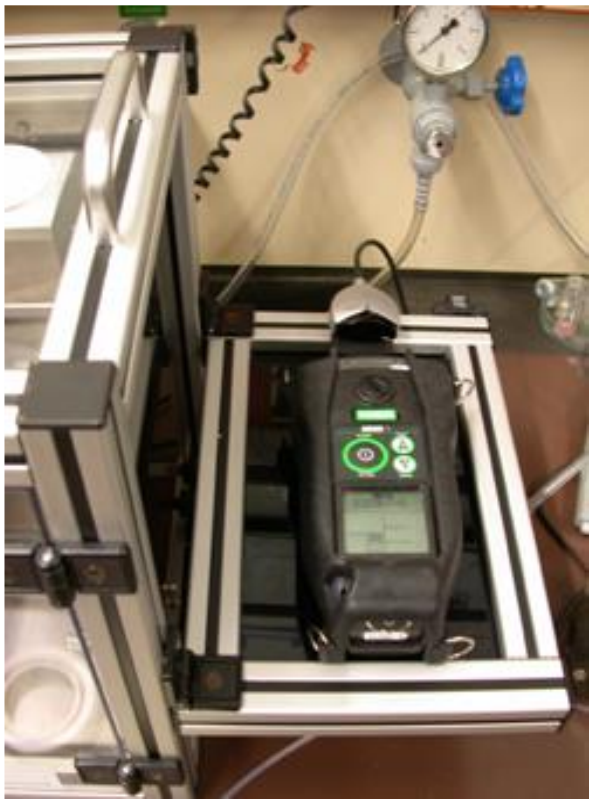
c.
Example of a measurement with the test chemical isopropanol

Test chemical	Penetration concentration [VOC]*	Start time	Penetration time	Permeation time
Isopropanol	8,4	08:48:45	10:24:00	**01:35:15 h**

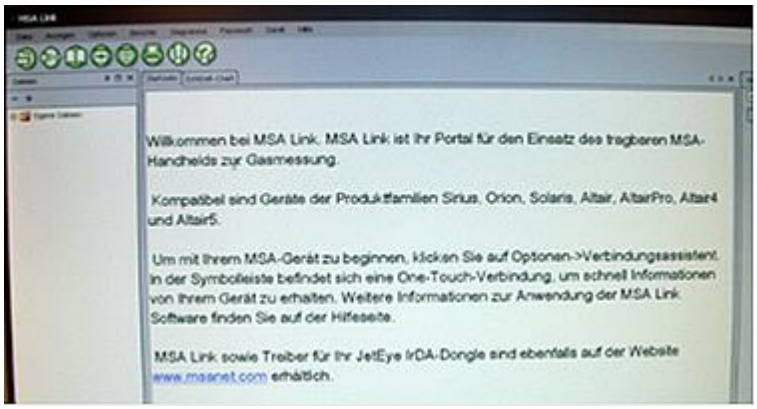
Time	VOC	Penetration concentration [VOC]
08:48:45	0	8,4
08:49:00	0	8,4
08:49:15	0	8,4
08:49:30	0	8,4
08:49:45	0	8,4
08:50:00	0	8,4
08:50:15	0	8,4
08:50:30	0	8,4
08:50:45	0	8,4
08:51:00	0	8,4
08:51:15	0	8,4
08:51:30	0	8,4
08:51:45	0	8,4
08:52:00	0	8,4

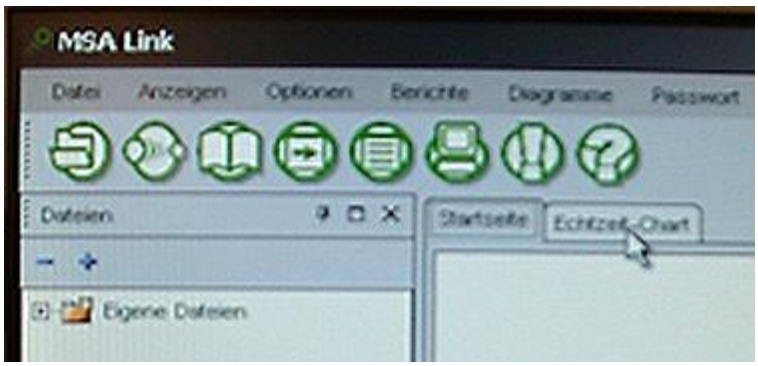
10:21:15	6,3	8,4
10:21:30	6,4	8,4
10:21:45	6,6	8,4
10:22:00	6,8	8,4
10:22:15	7	8,4
10:22:30	7,1	8,4
10:22:45	7,3	8,4
10:23:00	7,5	8,4
10:23:15	7,7	8,4
10:23:30	7,9	8,4
10:23:45	8,1	8,4
10:24:00	8,3	8,4
10:24:15	8,4	8,4
10:24:30	8,6	8,4
10:24:45	8,8	8,4
10:25:00	9	8,4
10:25:15	9,3	8,4

PERMOBIL 1.6_1 Viewing measurement data in real time



Connect the Jeteye PC IR adapter to the PID





Select ‘Echtzeit Chart’ (‘real time chart’) in the program MSA Link

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PERMOBIL 1.7 CE declaration of conformity

Konformitätserklärung
Declaration of conformity

LABC- Labortechnik, 53773 Hennef, Deutschland/Germany

Erklärt, dass das Produkt:
Declares that the product:

Geräteart/device: Handschuhtester/glove tester
Type: PERMOBIL

Mit den Vorschriften folgender Europäischer Richtlinien übereinstimmt:
Complies with the requirements oft he European Directives:

EG-Richtlinie	89/336/EG	-EMV
EC-Directive	89/336/ECC	-emc
EG-Richtlinie	73/23/EG	-Niederspannung
EC-Directive	73/23/EEC	-low voltage

Die Übereinstimmung des Produktes mit den Anforderungen der Richtlinie 73/23/EG wird nachgewiesen durch die Einhaltung der folgenden harmonisierten europäischen Normen:
Conformance oft the product with the requirements of directive 73/23/EEC is approved by compliance with the following harmonized european standard:
EN 61010-1:2001
Sicherheitsbestimmungen für elektrische Mess-, Steuer-,Regel- und Laborgeräte.
Safety requirements for electrical equipment for measurment, control and laboratory use.
EN61326-1/ EN61326/A1 Störfestigkeit/electromagnetic susceptibility
Diese Erklärung bescheinigt die Übereinstimmung mit den genannten Richtlinien, beinhaltet jedoch keine Zusicherung von Eigenschaften im rechtlichen Sinne.
This declaration certifies conformance with the above mentioned directives. Affirmatition of attributes in a legal sense is not included.
Die Sicherheitshinweise der mitgelieferten Produktdokumentationen sind zu beachten.
Security declarations given in the product documentation have to be considered.
Hennef, den 01.01.2012

Werner Zillger
(Leitung Entwicklung/ Head of development)