



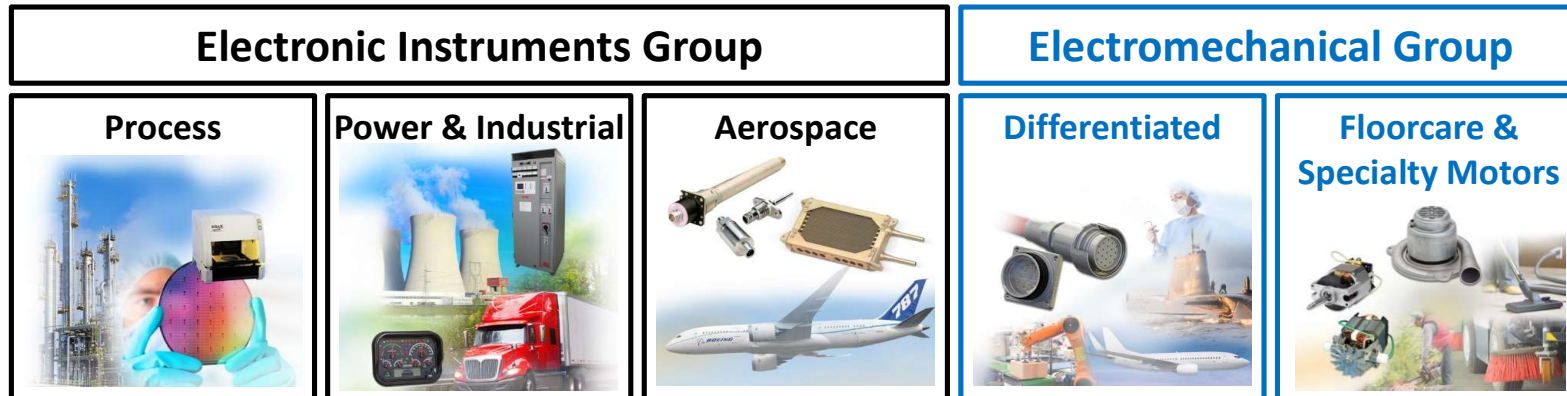
**AMETEK MOCON**  
**OTR and WVTR Measurement**  
**of Films, Paper and Packages**

Christoph Zerwas



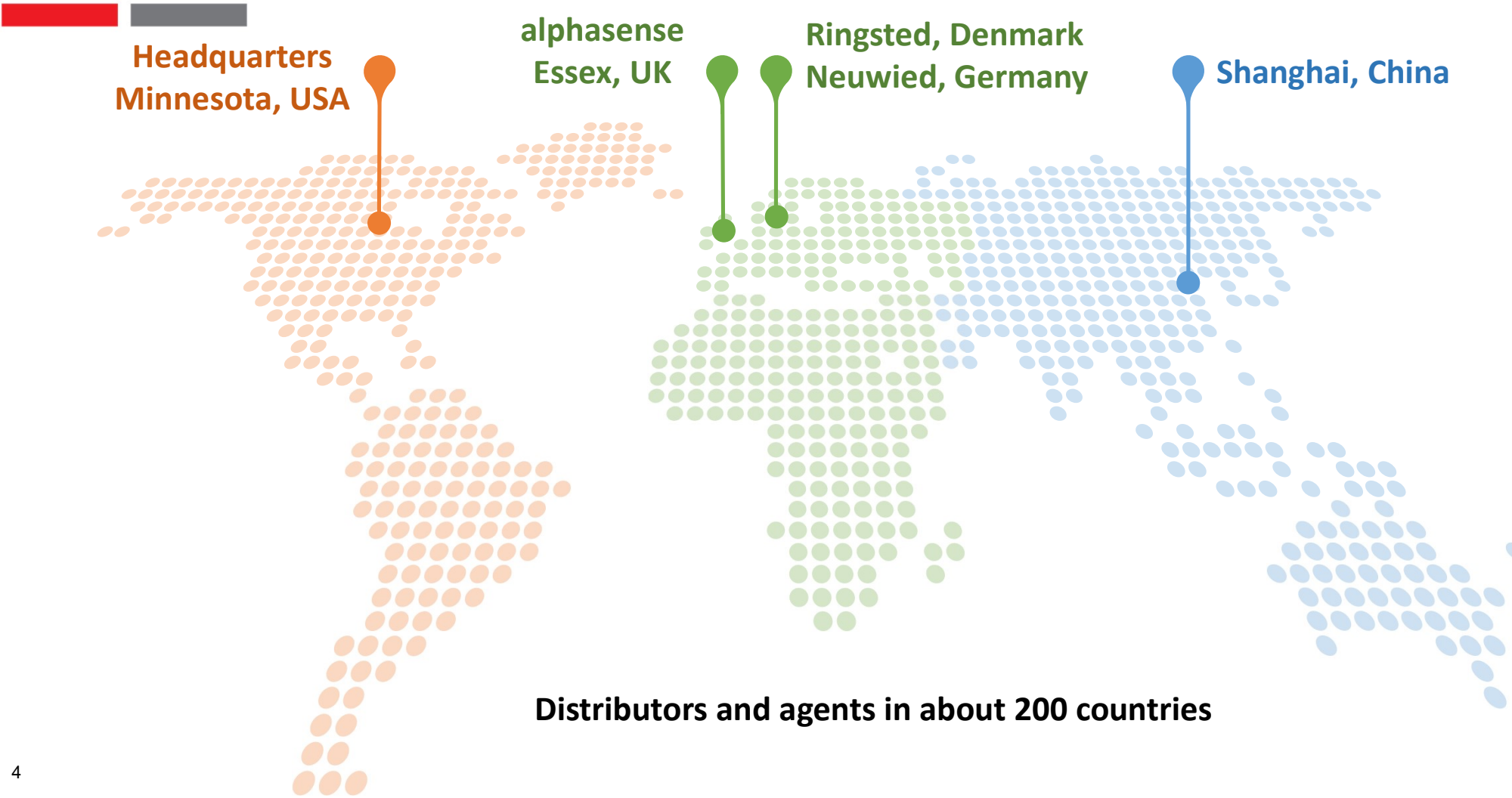
# AMETEK MOCON – INTRODUCTION

- Global manufacturer of high-tech systems for demanding applications and niche markets
- Ca. 18.000 employees
- Yearly turnover ca. 5 Mrd. US\$ with more than 50 % outside USA





# AMETEK MOCON Locations



# AMETEK MOCON Brands



High-quality gas sensors for industrial safety and air quality. Wide product portfolio, multiple sensor technologies and reliable performance.



High-precision and reliable gas and vapour permeation analyzers, gas chromatographs and dairy analyzers

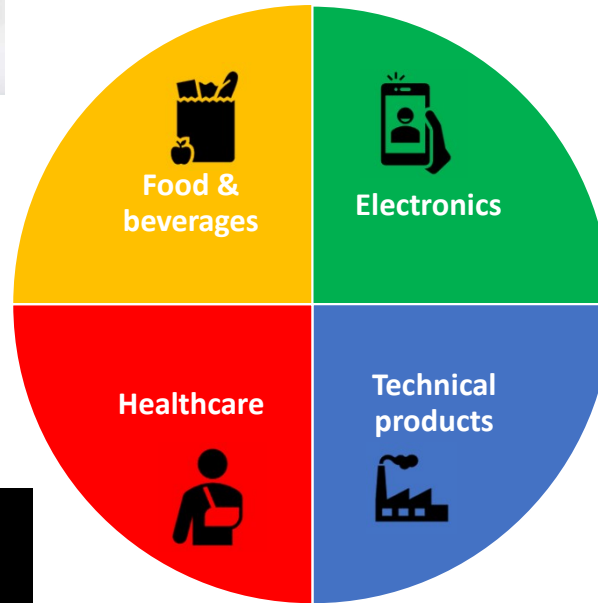


Headspace gas analyzers and gas mixers for Modified Atmosphere Packaging (MAP) as well as leak detectors for food, pharmaceutical and medical products packaging



## MOCON permeation product line

# AMETEK MOCON Permeation measurement





# WHAT IS PERMEATION, OTR, WVTR AND CO<sub>2</sub>TR?



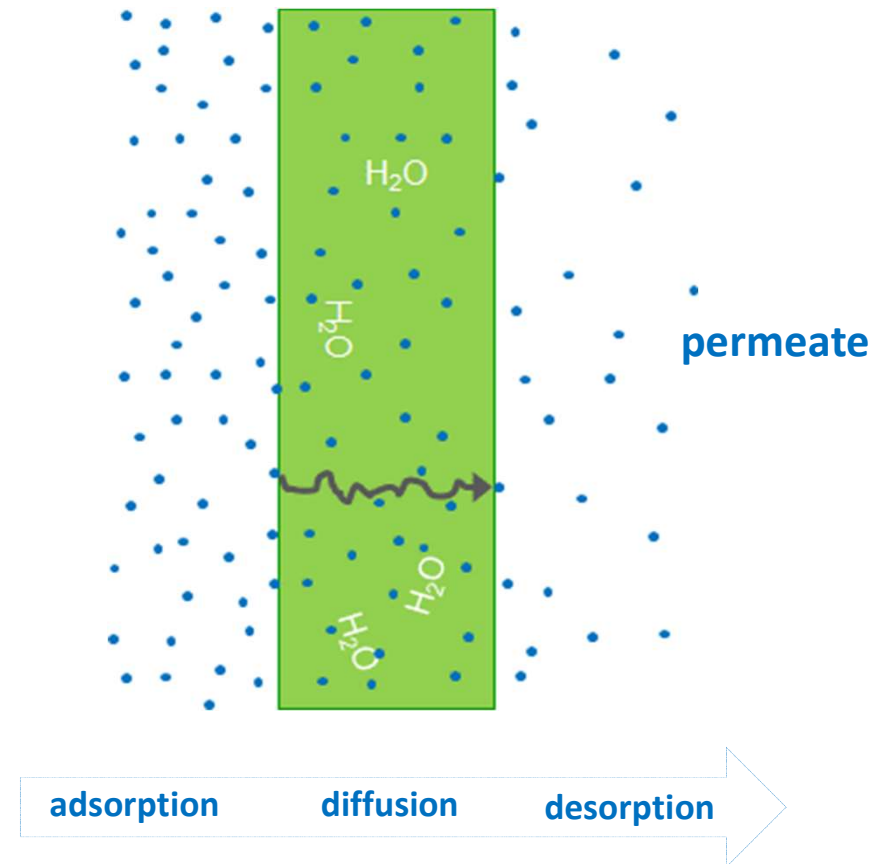
# BASICS What is permeation, OTR, WVTR and CO<sub>2</sub>TR?

Permeation = movement of gas or vapour through a barrier

OTR = oxygen transmission rate

WVTR = water vapour transmission rate

CO<sub>2</sub>TR = carbon dioxide transmission rate





**Transmission rate**  
**=**  
**amount of permeate**  
**which in a certain period of time permeates**  
**through a barrier of a certain cross sectional area**

- **WVTR:**            **g / (m<sup>2</sup> \* day)**
  - **OTR:**             **cm<sup>3</sup> / (m<sup>2</sup> \* day)**
  - **CO<sub>2</sub>TR:**        **cm<sup>3</sup> / (m<sup>2</sup> \* day)**
- }                    **films, paper etc.**
- **paper, hollow bodies**

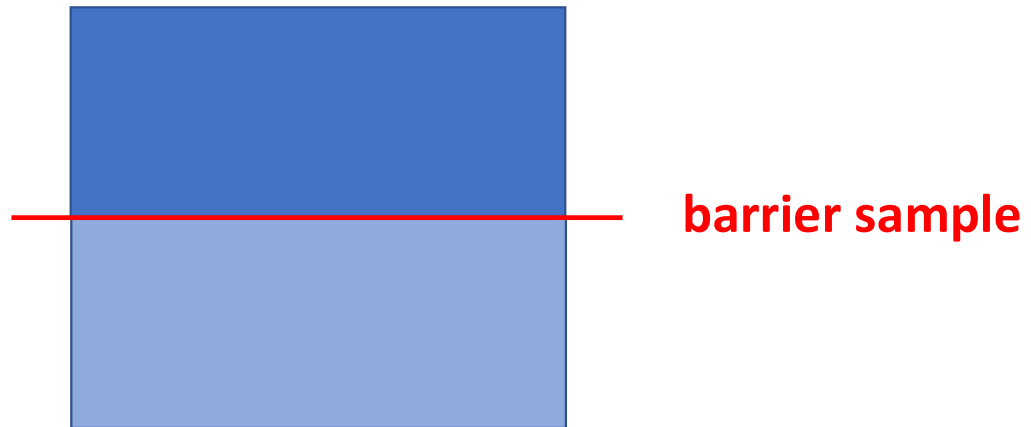
- **Partial pressure of permeate**
- **Chemical structure of barrier**
- **Thickness of barrier**
- **Cross sectional area of barrier**
- **Temperature**
- **Humidity**



# PERMEATION MEASUREMENT

# MEASUREMENT Functional principle

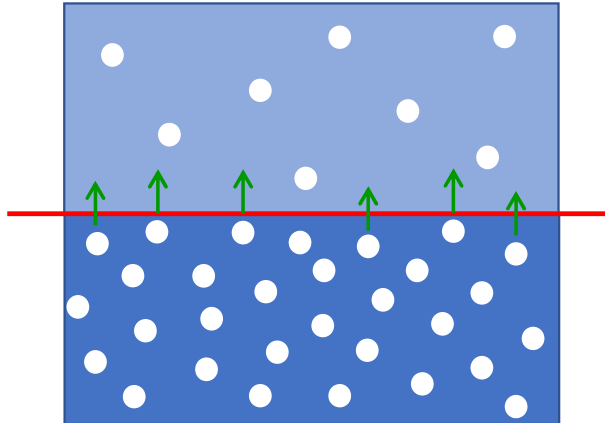
**Diffusion cell  
made of two half-cells  
which are separated  
by the sample**





# MEASUREMENT Functional principle

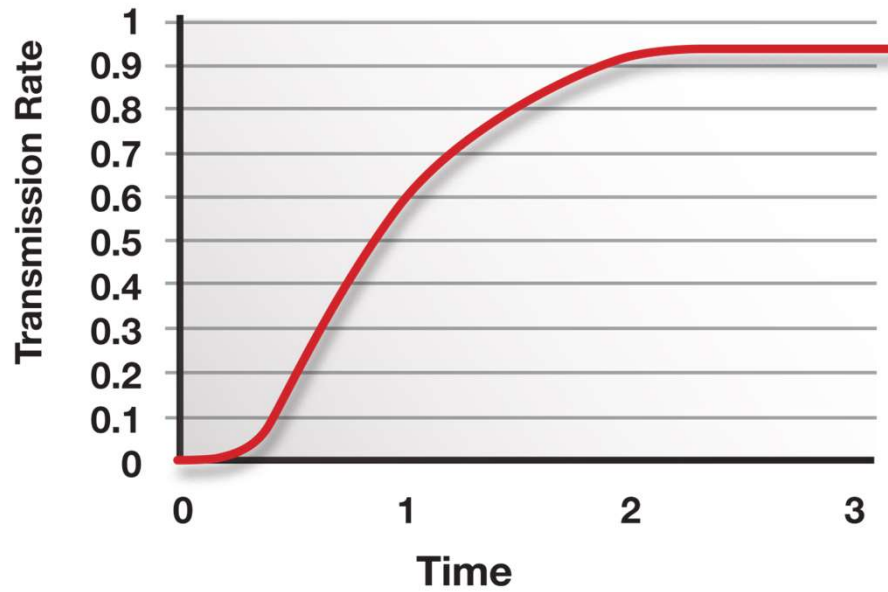
low concentration or 0  
= sensor side



high concentration  
= test gas side

Absolute pressure  
on both sides is  
identical

# MEASUREMENT Functional principle

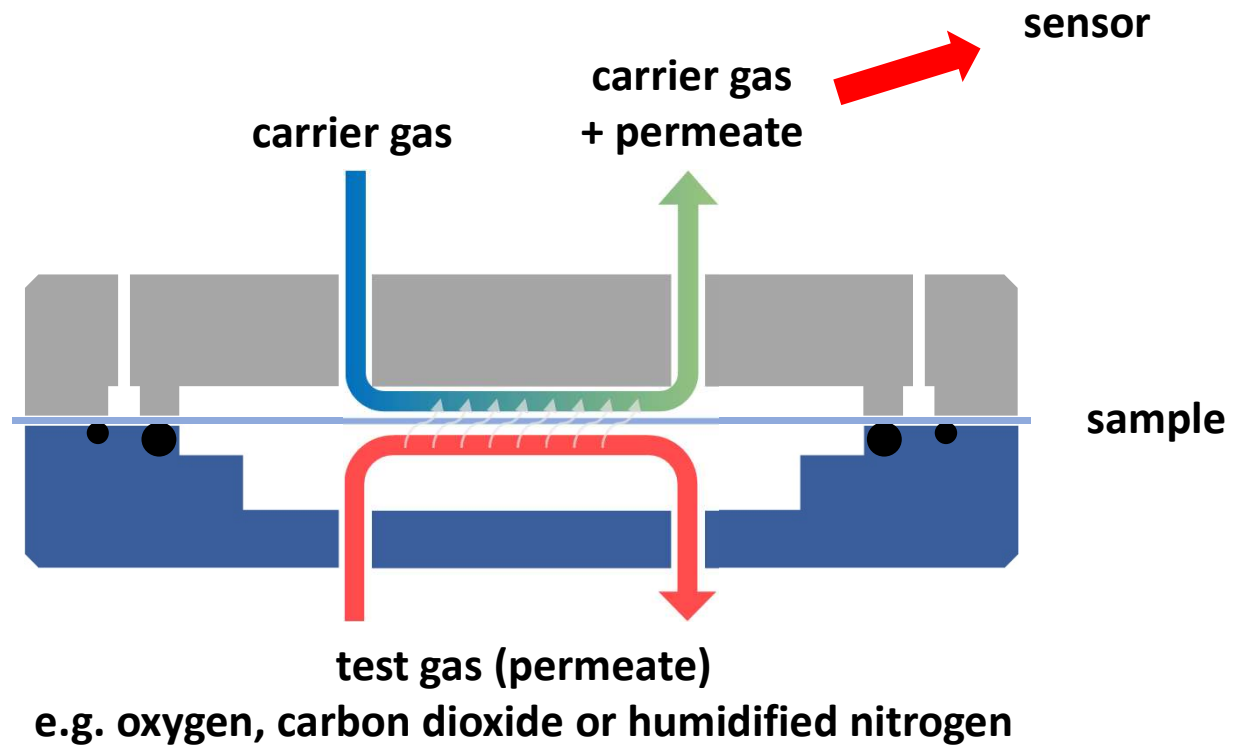


**Measurement is finished when the permeate flow through the sample comes to an equilibrium**



# MEASUREMENT OF FILMS

# FILM MEASUREMENT Functional principle



# FILM MEASUREMENT Sample cartridge





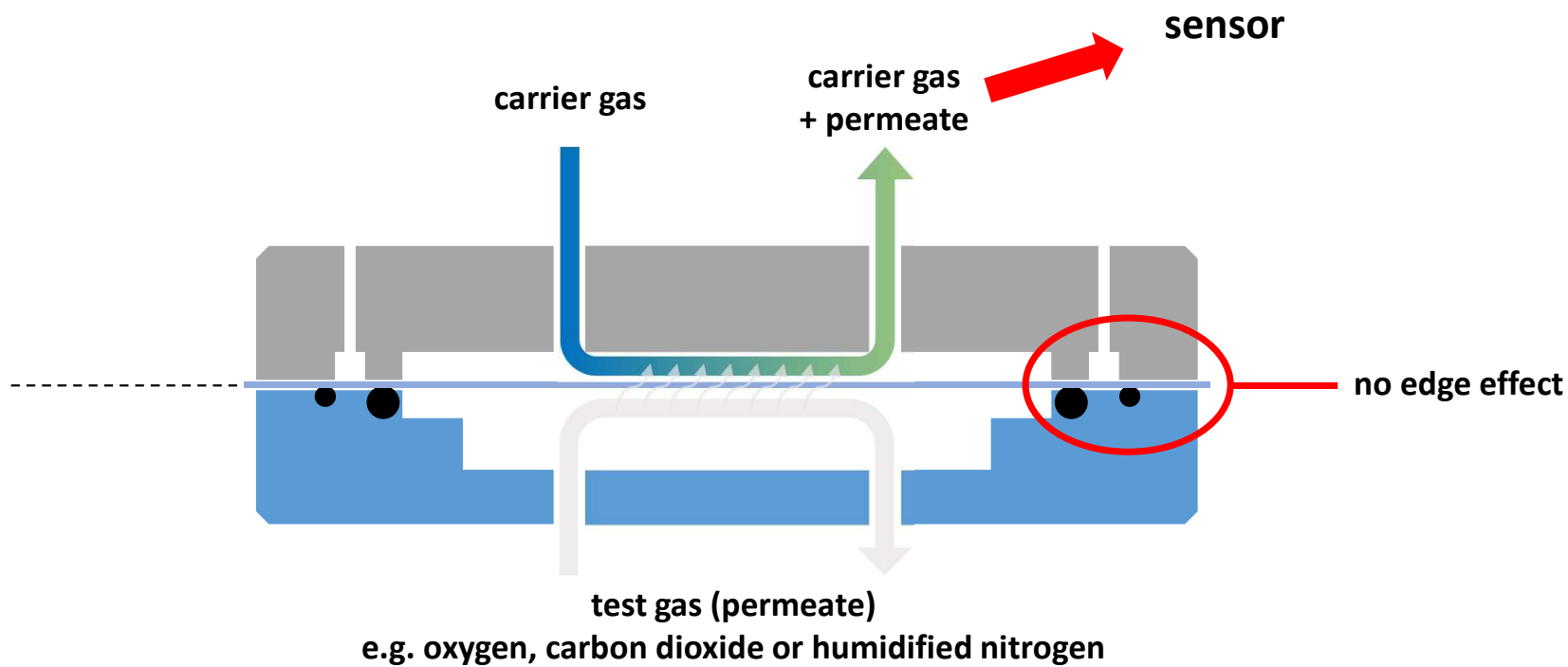


**OX-TRAN 2/22 H, L and 10X**  
**OX-TRAN 2/12 R**  
**OX-TRAN 2/28**  
**PERMATRAN-W 3/34 H and G**  
**AQUATRAN 3**  
**AQUATRAN 3/38**

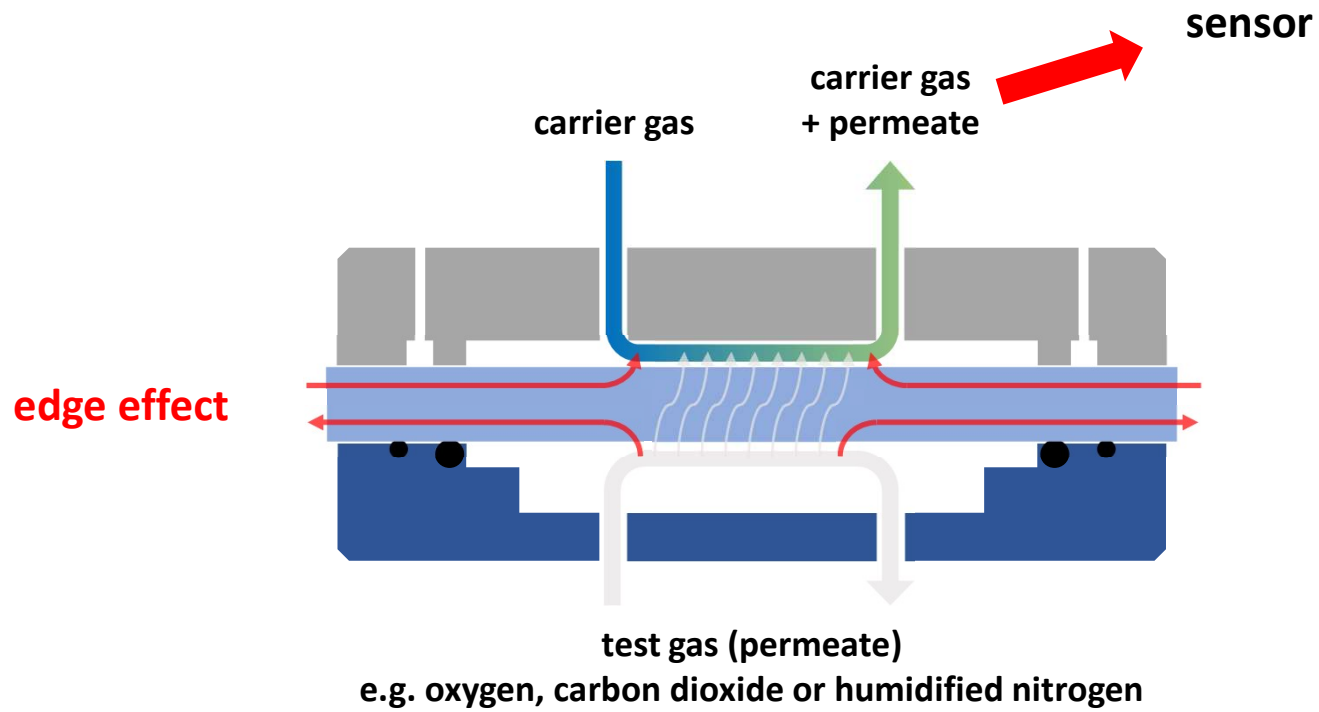


# MEASUREMENT OF PAPERS

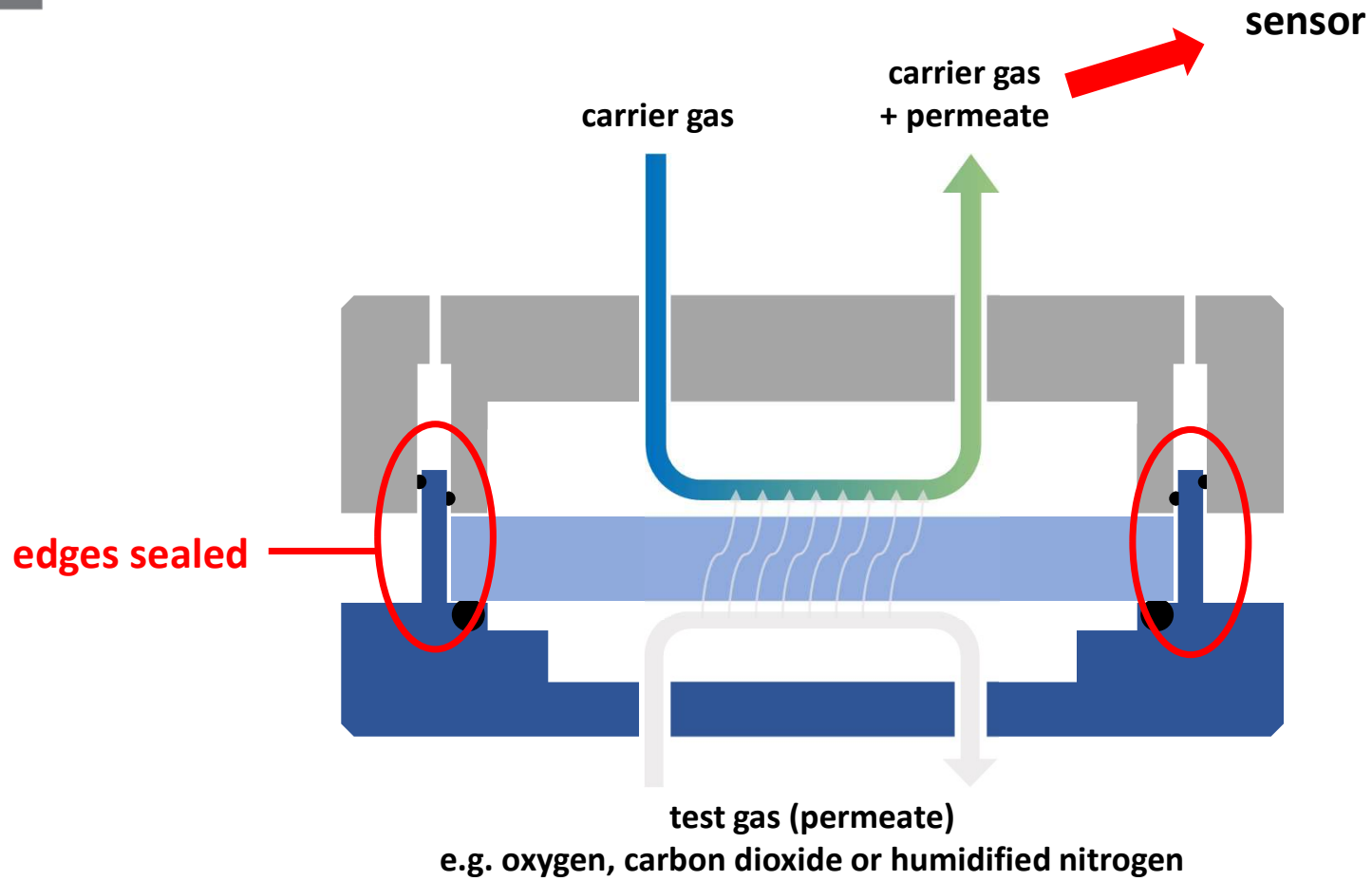
# PAPER MEASUREMENT Edge effect



# PAPER MEASUREMENT Edge effect of papers and cardboard



# PAPER MEASUREMENT Edge effect of papers and cardboard





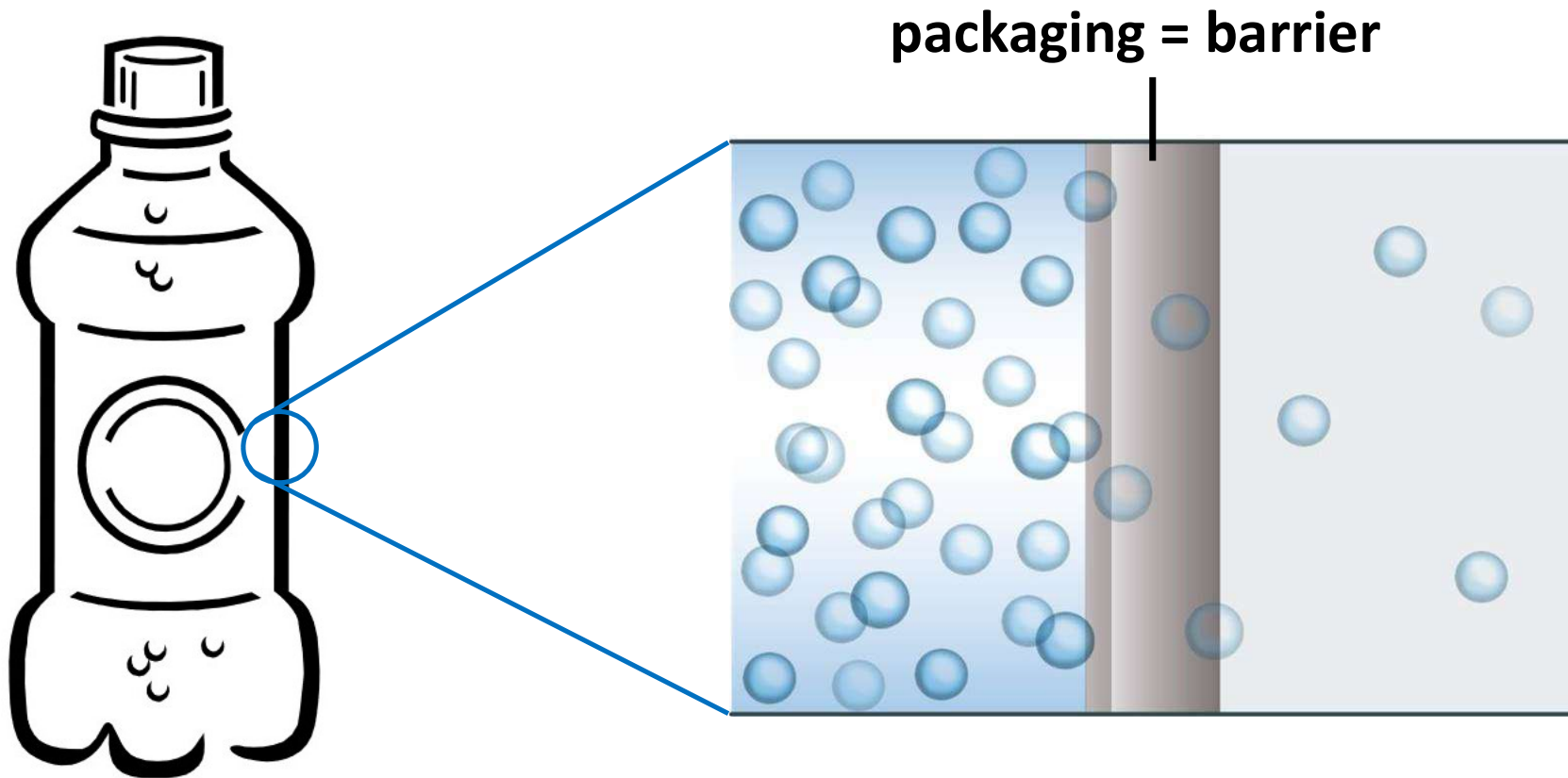
# PAPER MEASUREMENT Edge effect cartridges



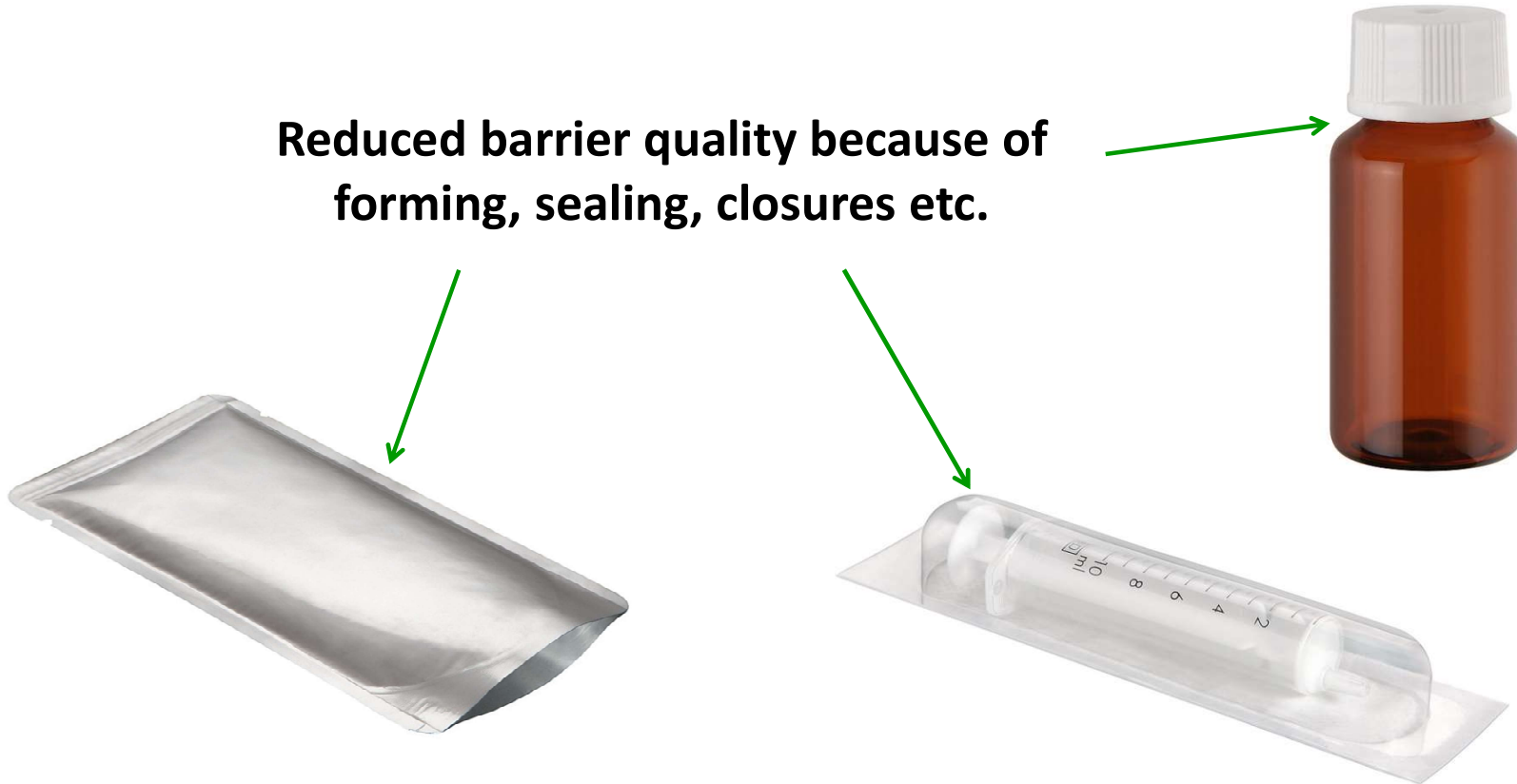


# MEASUREMENT OF PACKAGES AND OTHER HOLLOW BODIES

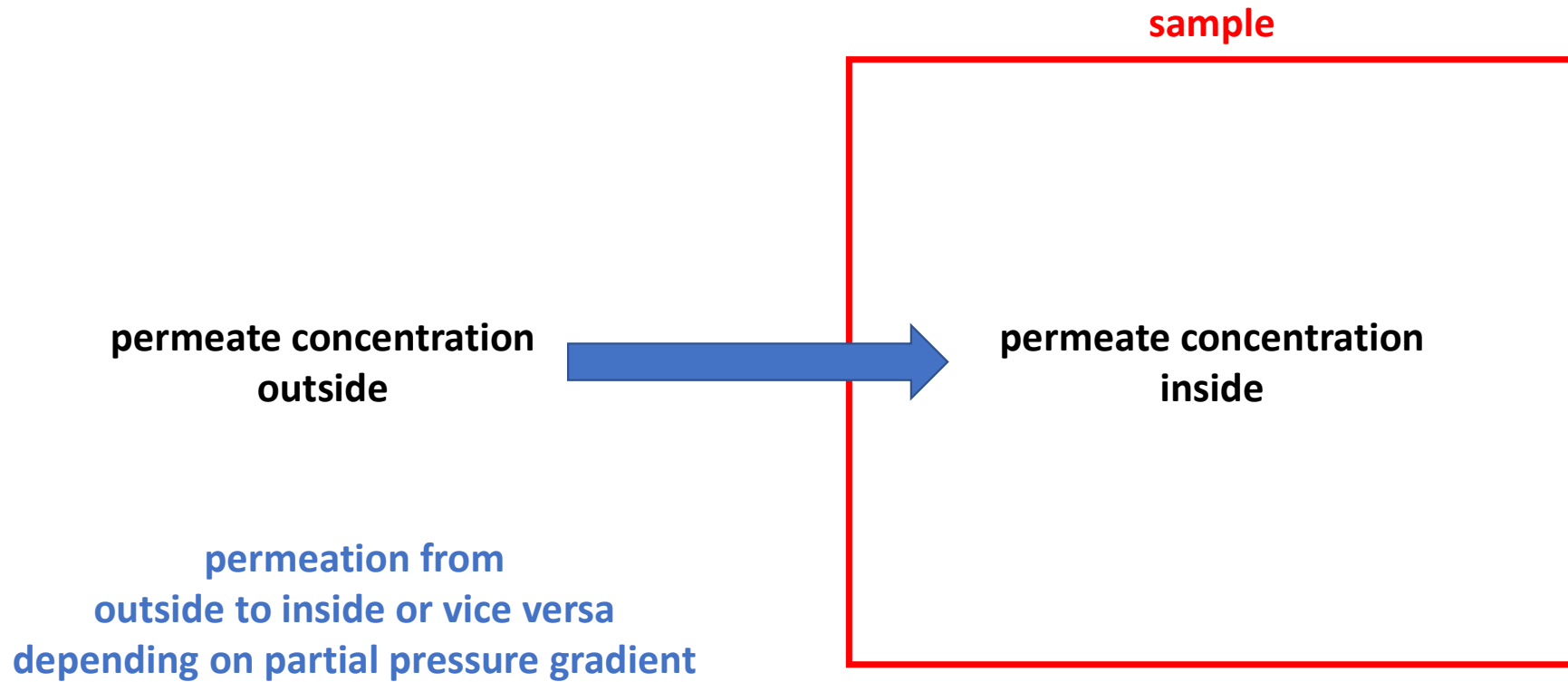
# PACKAGE MEASUREMENT



**Reduced barrier quality because of forming, sealing, closures etc.**



# PACKAGE MEASUREMENT Functional principle



# PACKAGE MEASUREMENT Cartridge for small blisters



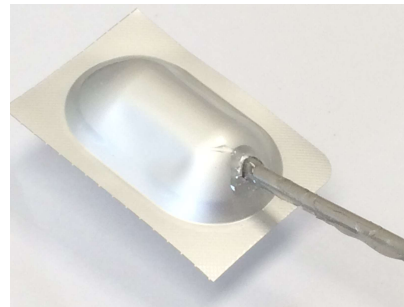
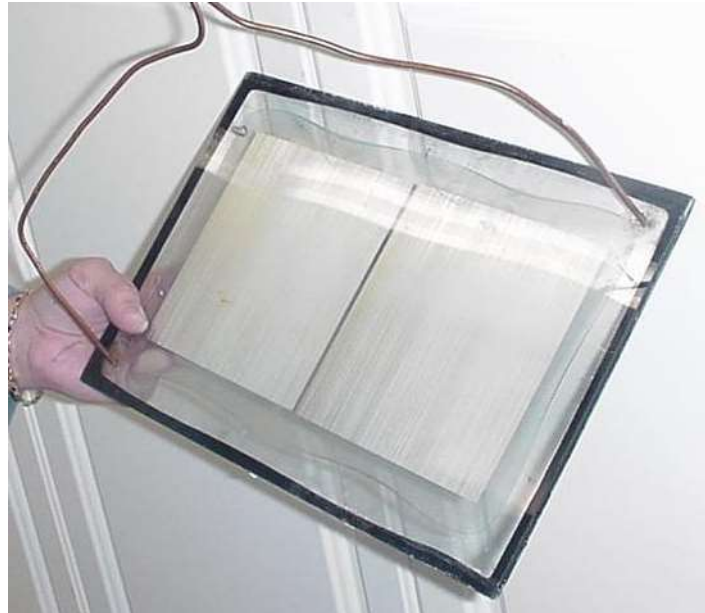
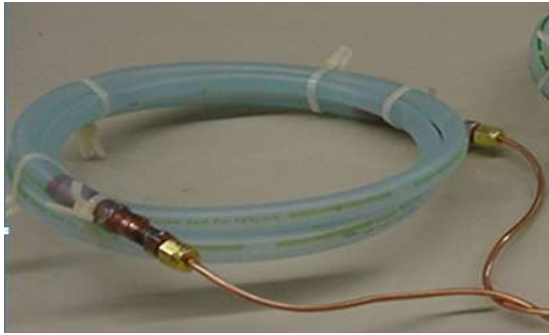
# PACKAGE MEASUREMENT Remote adapter cartridge



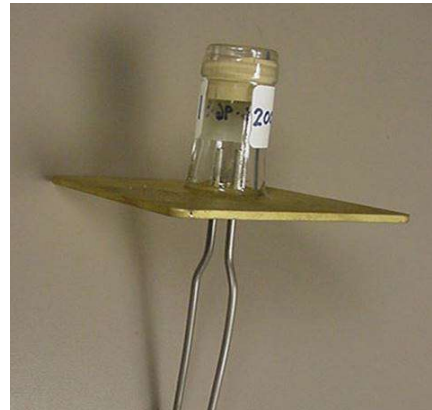
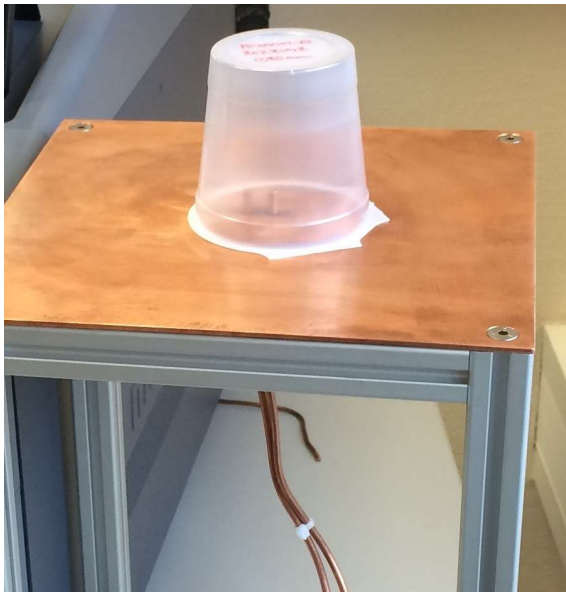
carrier gas circuit



# PACKAGE MEASUREMENT Examples



# PACKAGE MEASUREMENT Examples

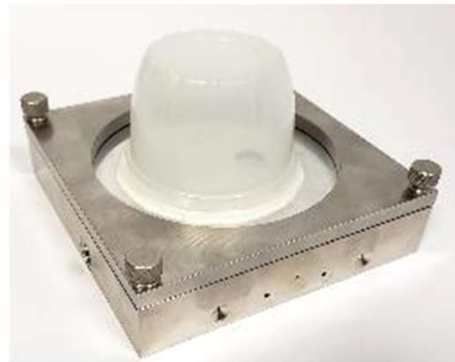
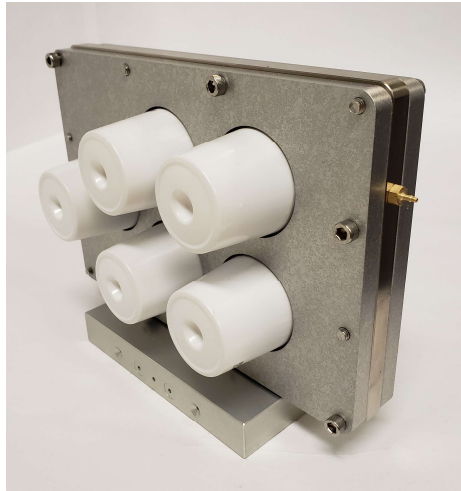


# PACKAGE MEASUREMENT PackRack and package adapters

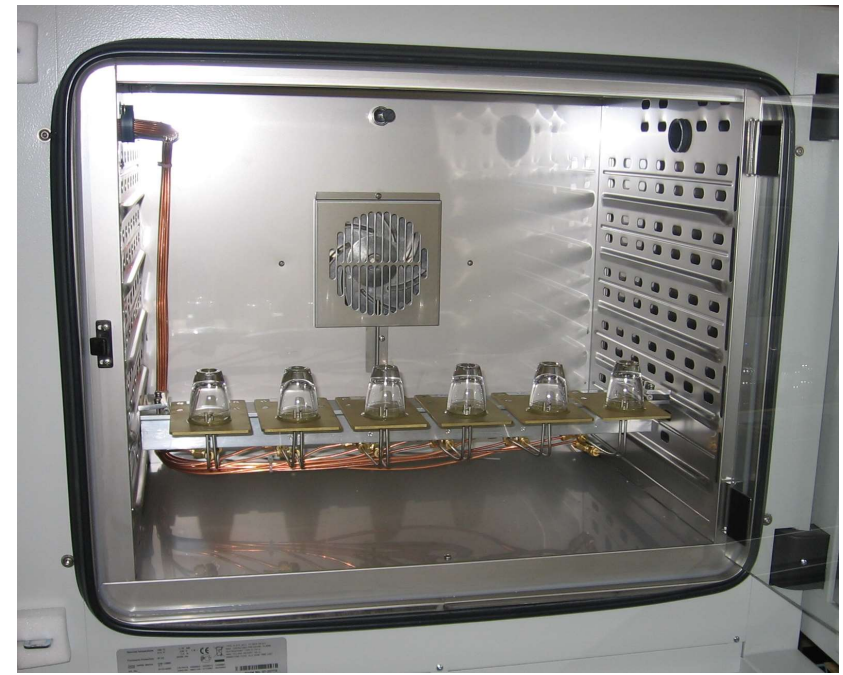




# PACKAGE MEASUREMENT Package adapters



# PACKAGE MEASUREMENT External climate chamber



**PACKAGE MEASUREMENT** Instrument with integrated climate chamber



**OX-TRAN 2/40 and AQUATRAN 3/40**

**PACKAGE MEASUREMENT** OTR measurement at ambient air



**OX-TRAN 2/48**





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