

Vacuum and Pressure decay leak testing

Basel, 01. June 2022

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Overview

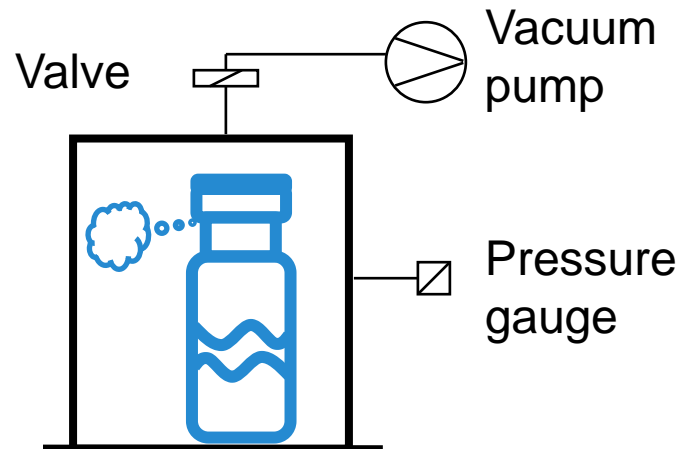
- Fundamentals of DP method
 - LFC, P, V (different types)
 - pressure curve / course
 - steps of the differential pressure test
- Method selection
- Equipment in process control
- Applications of differential pressure
 - Inline vs. lab scale Systems
 - Inline systems

Fundamentals of DP

LFC, P, V

Working principle – general

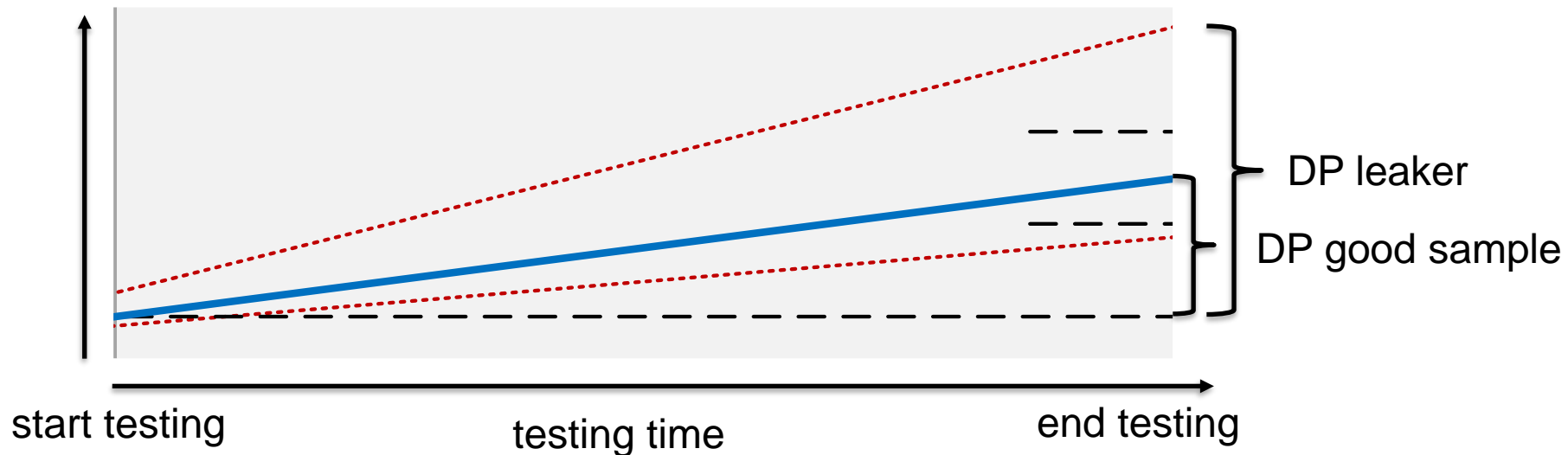
- Enclose sample in sealed and tight chamber
- Apply either under- or overpressure to the chamber
- Cut the inside of the chamber from vacuum / pressure supply
- Monitor the pressure in the chamber by highly sensitive sensors
- If a mass transfer is possible between the inside of the sample and the volume in the chamber (either way) the course of the pressure in the chamber will be different from the one of a tight sample



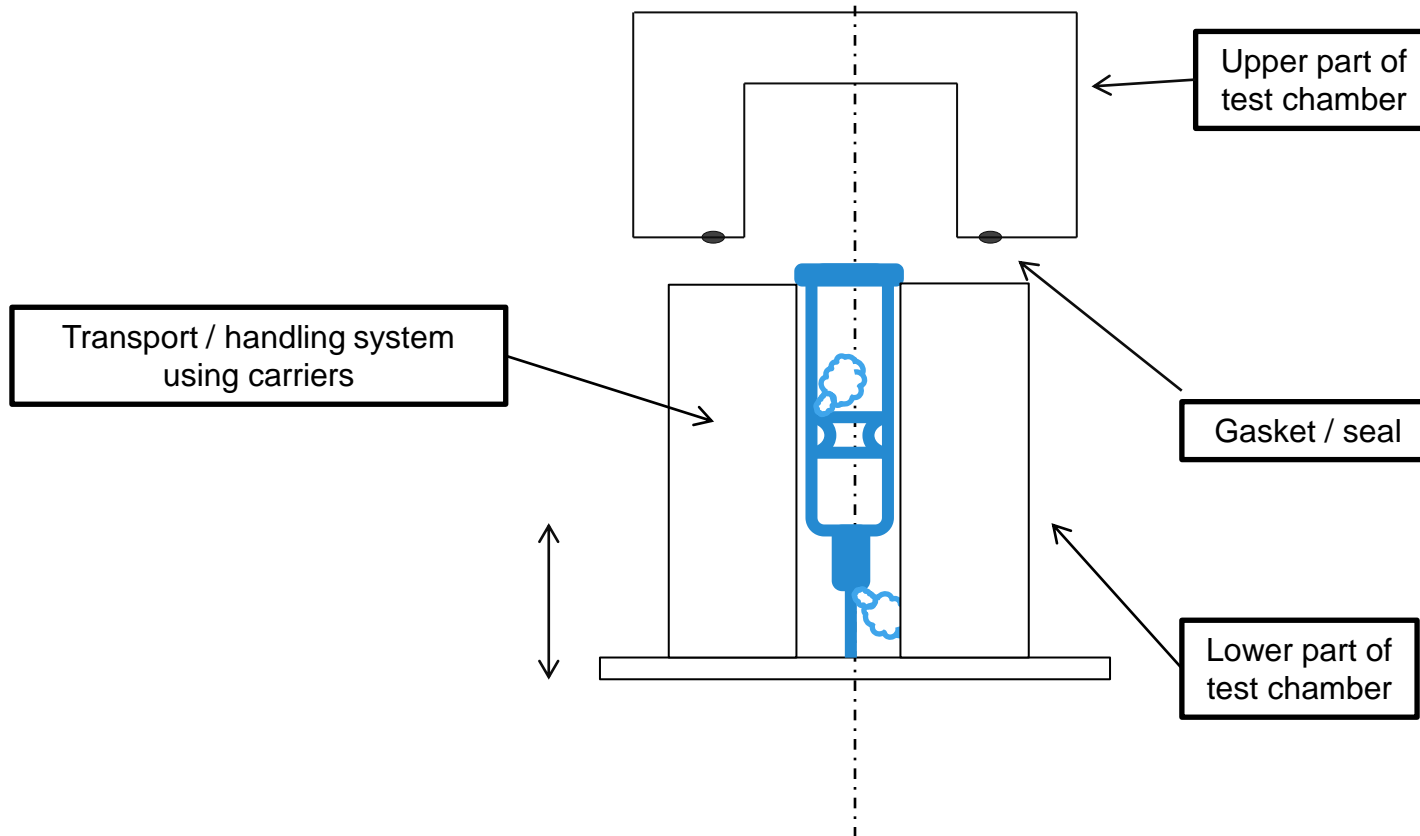
Working principle – DP test

- pressure course to be expected for a vacuum test
- expected change in pressure over time vs. change in pressure for leaker

pressure

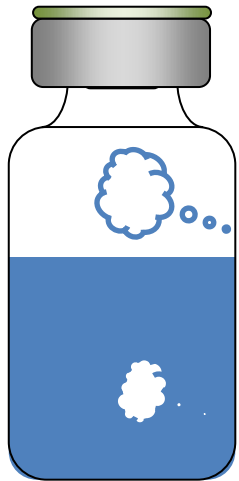


Lower / upper chamber



DP – variations

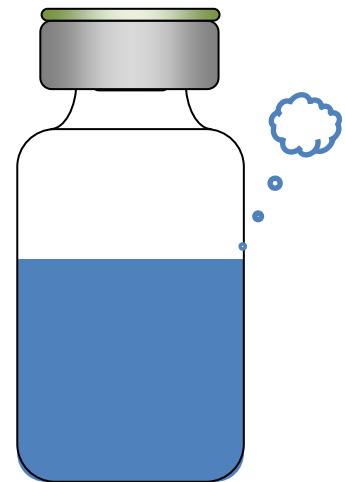
Pressure decay (P)



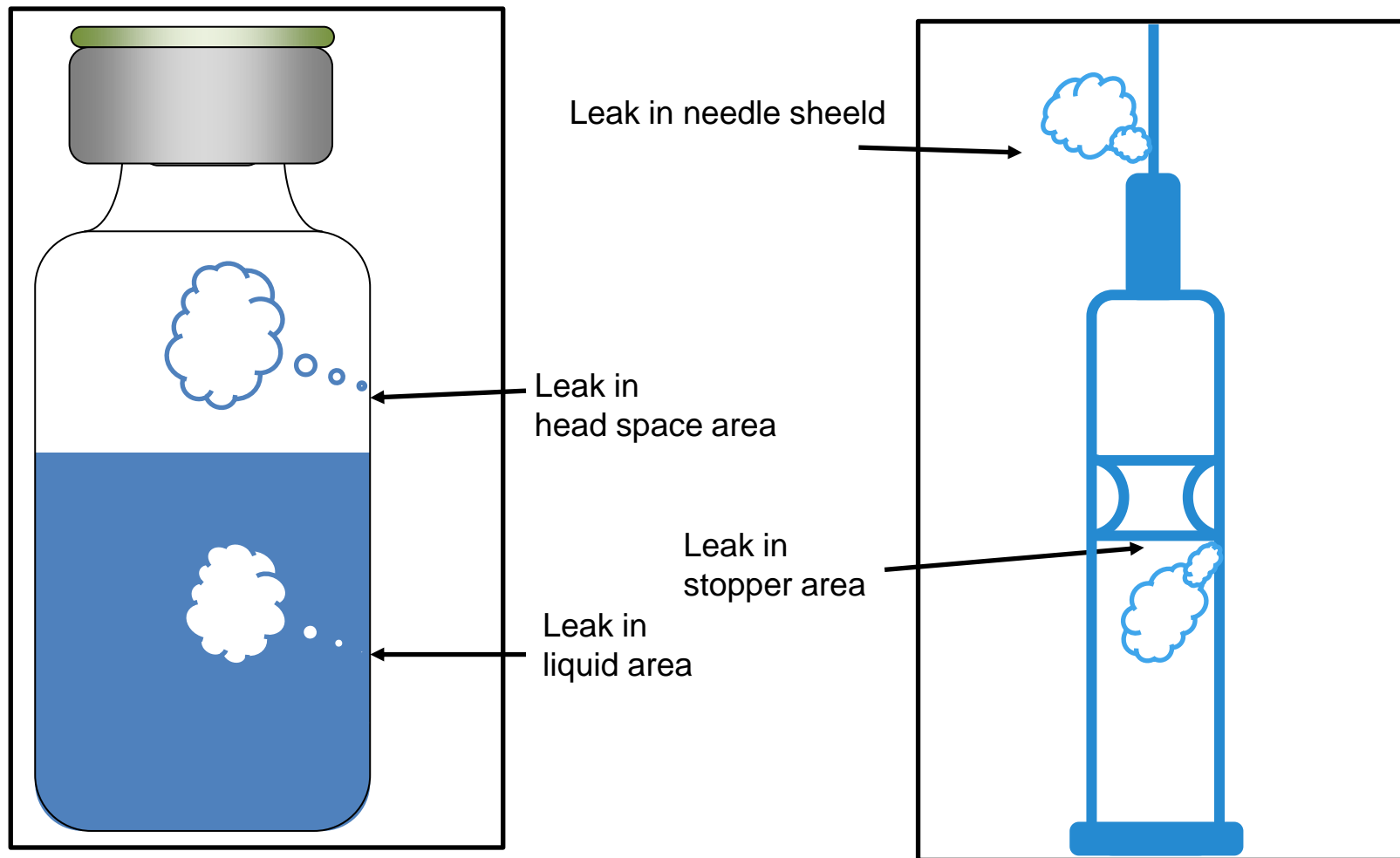
Vacuum decay (V)



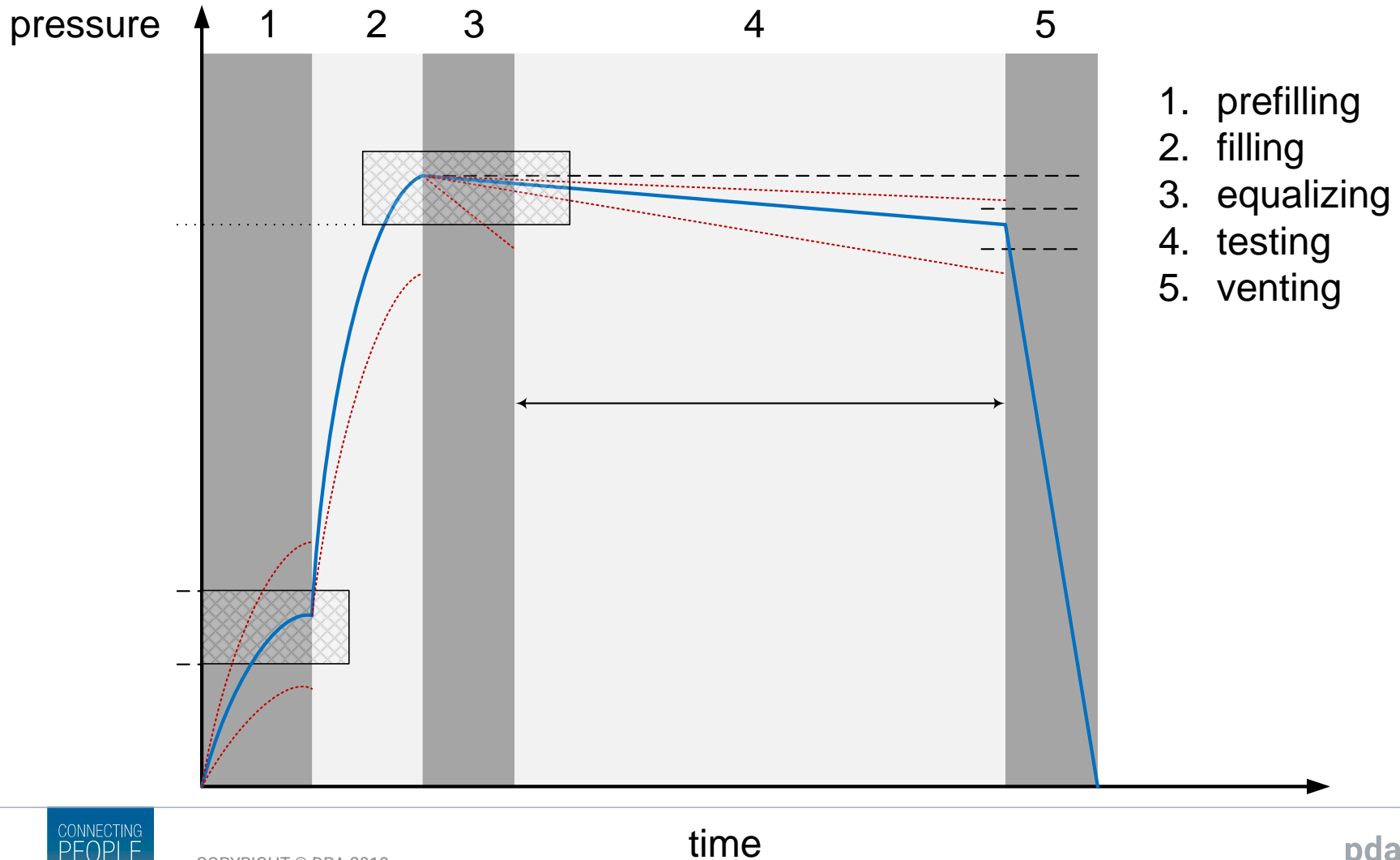
Deep vacuum with vaporization (LFC)



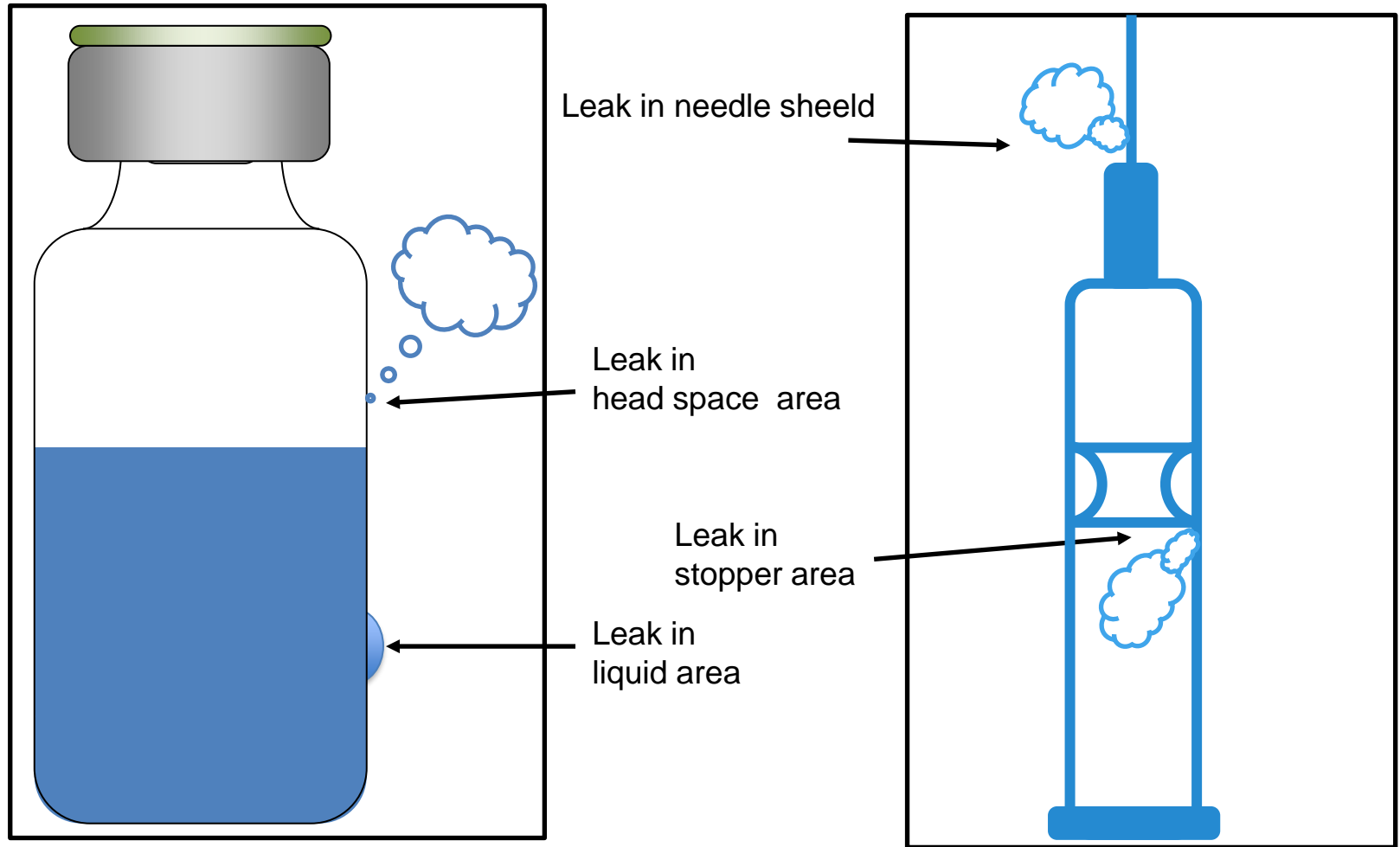
DP – Pressure decay



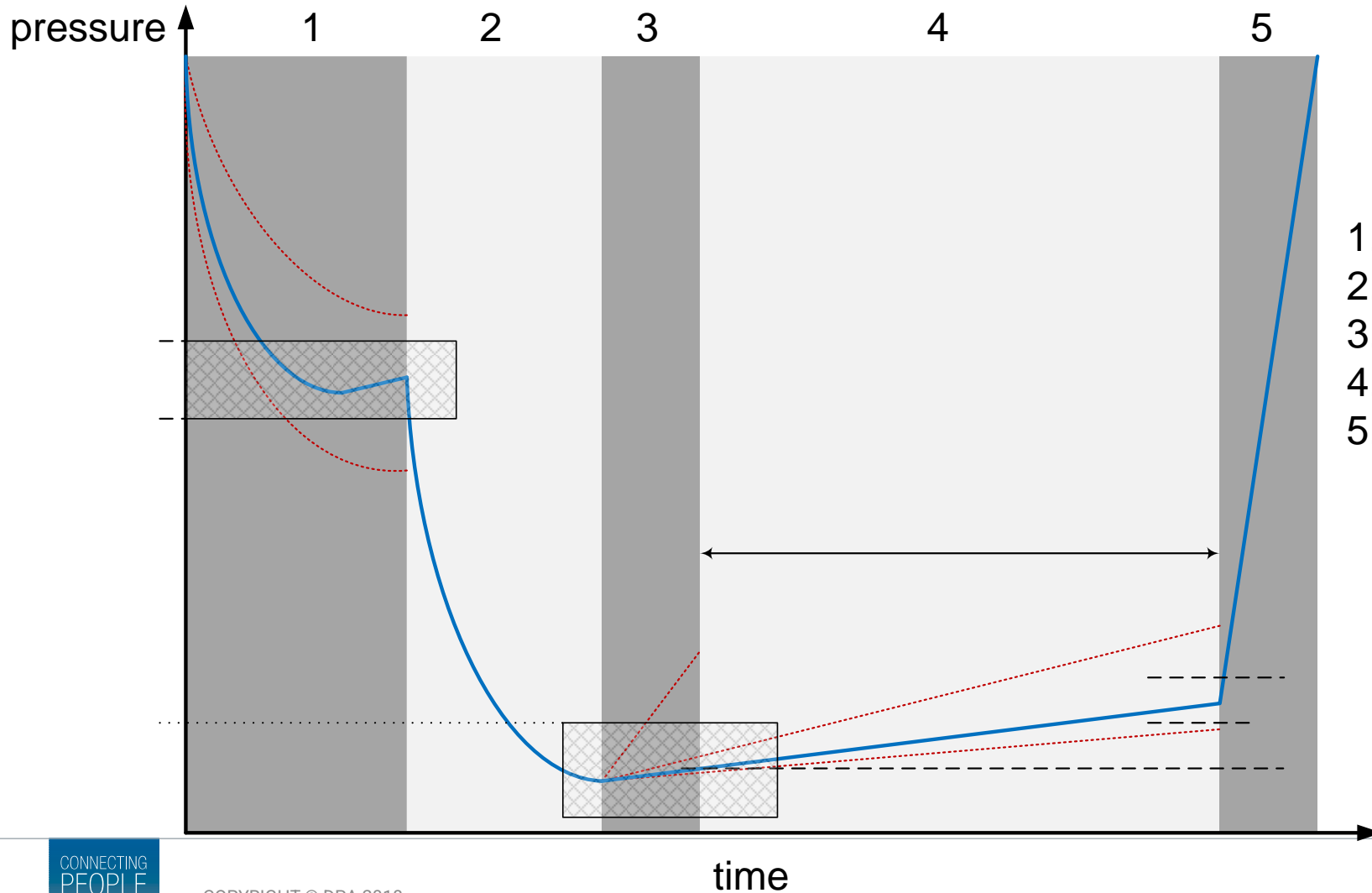
P - pressure course



DP – Vacuum decay

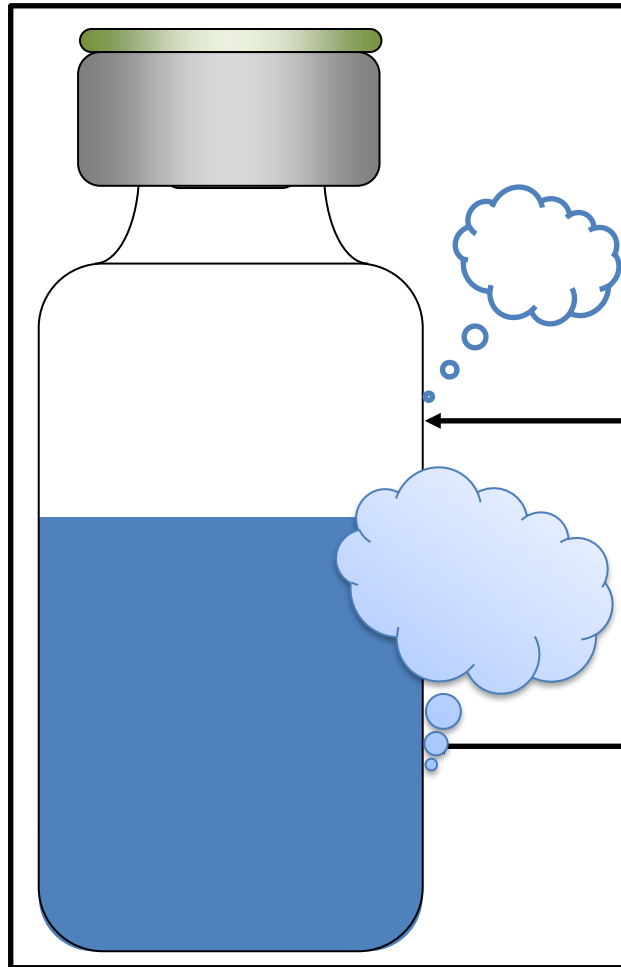


V – Pressure course



1. prefilling
2. filling
3. equalizing
4. testing
5. venting

DP – Deep vacuum decay - LFC[®]



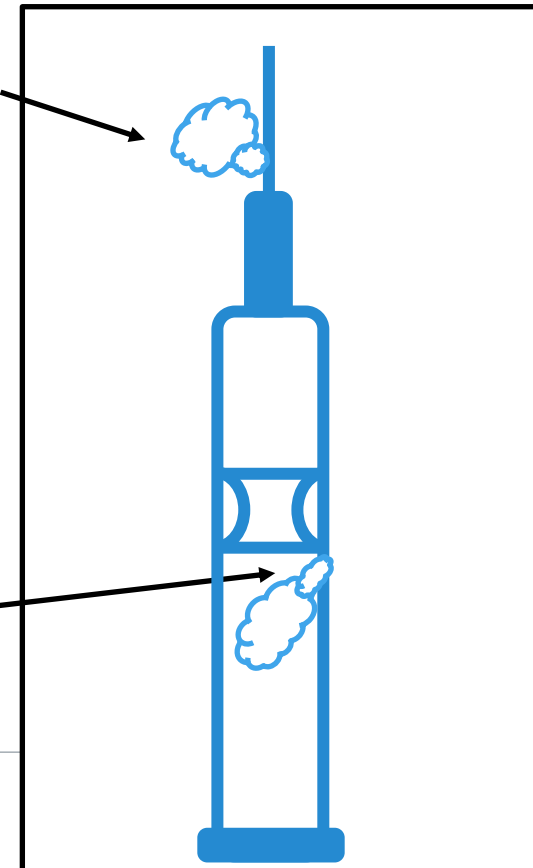
Leak in head space area

Leak in liquid area

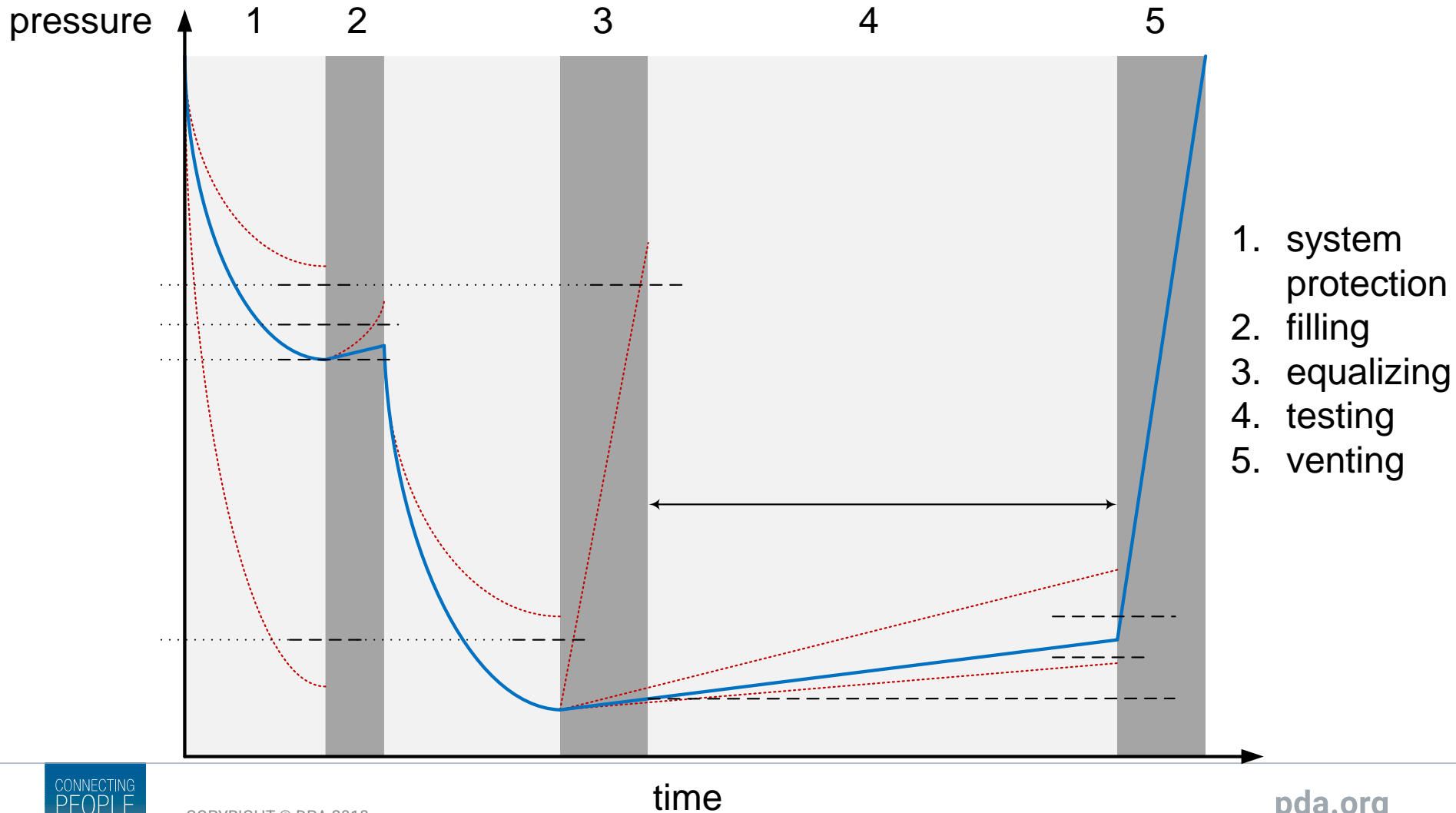
Test chamber is evacuated below the water vapor pressure (e.g. 23.4 mbar absolute @ 20 °C)

Leak in needle shield

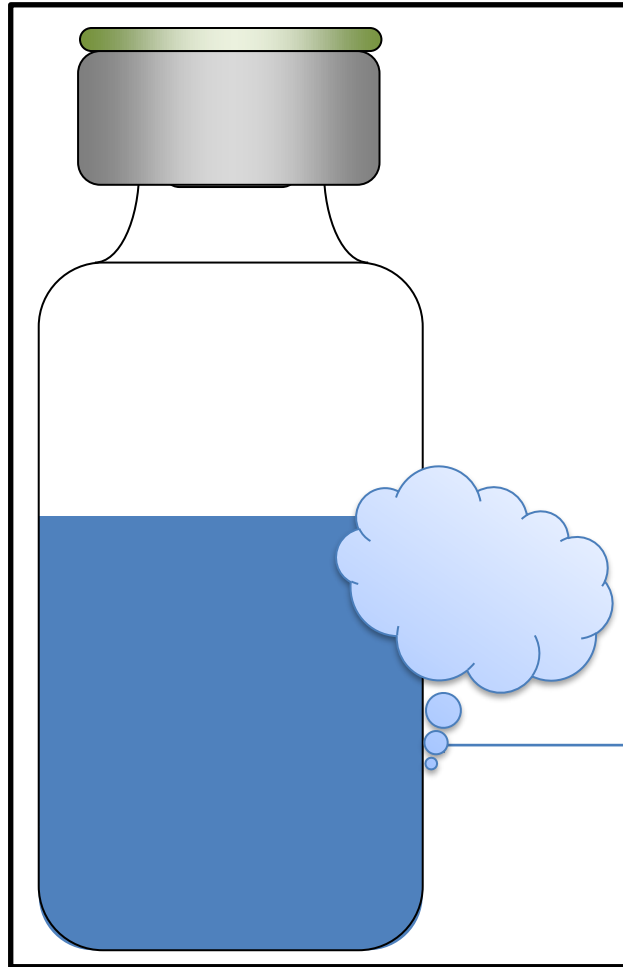
Leak in stopper area



LFC® – pressure course

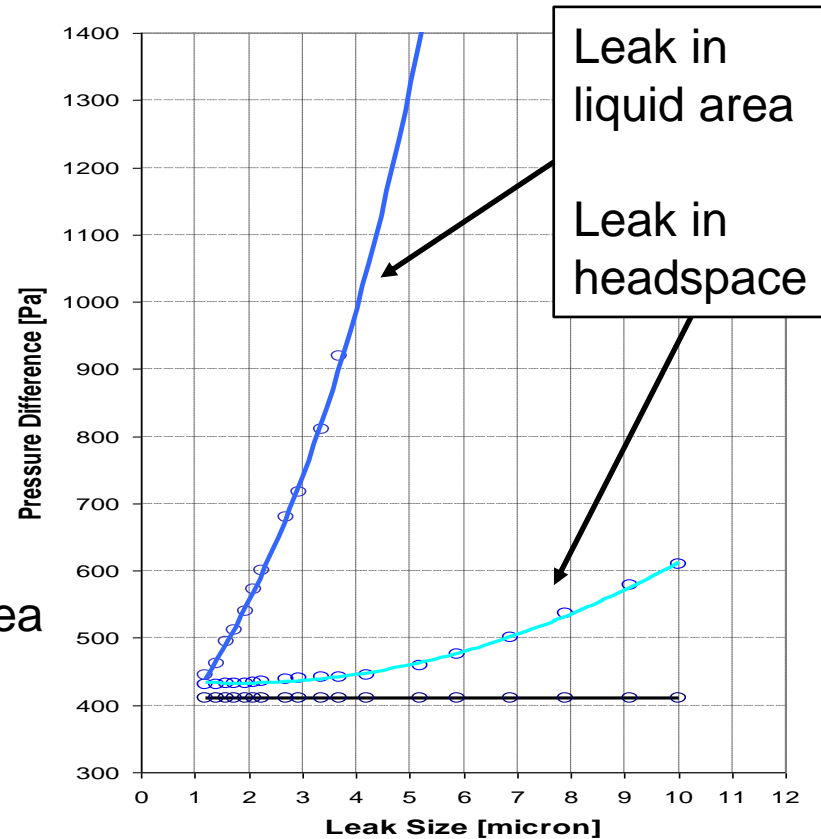


DP – Deep vacuum decay - LFC[®]



Volume of liquid water is enlarged many times over by the phase transition to gas

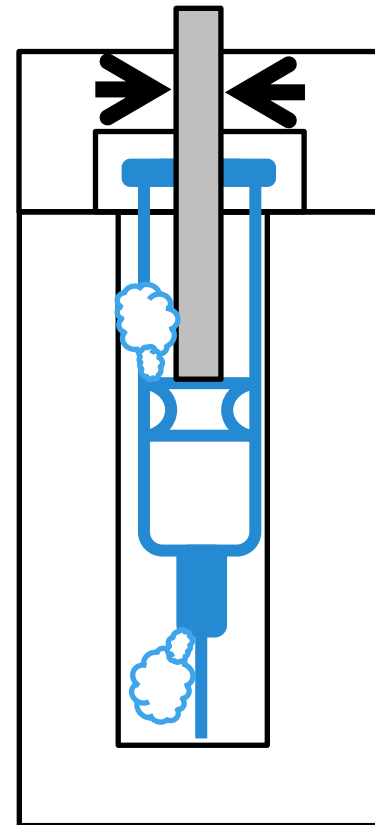
Leak in liquid area



Leak in liquid area
Leak in headspace

Syringes

- Prevention of stopper movement
- Fixation of stopper with a pin
- Test entire syringe at once
- No additional manipulation of sample



Method selection

LFC, P, V

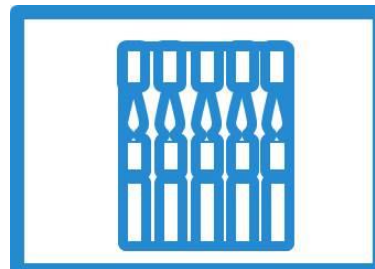
DP – Applicable containers



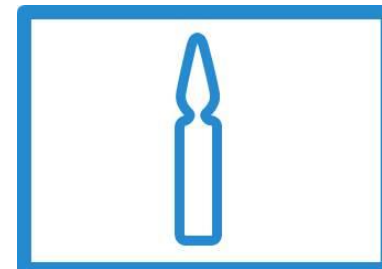
Liquid Vial



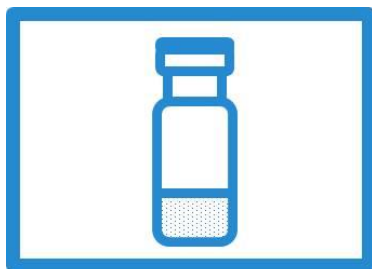
Syringe



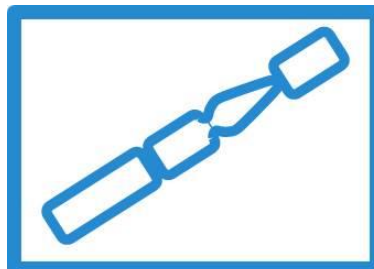
BFS Card



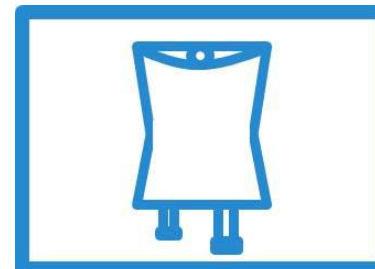
Ampoule



Lyo Vial



BFS Amp



IV Bag

DP – containers / contents

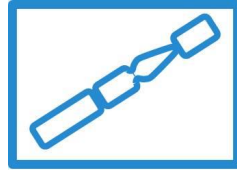
LFC



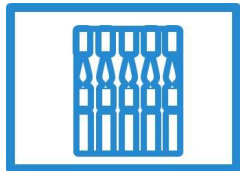
Liquid Vial



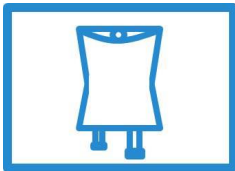
Syringe



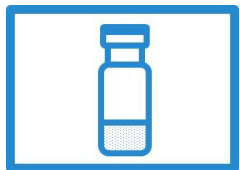
BFS Amp



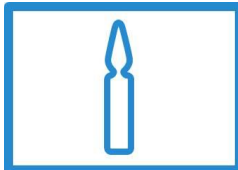
BFS Card



IV Bag

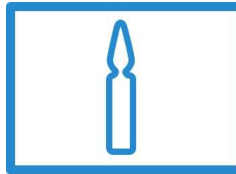


Lyo Vial



Ampoule

P



Ampoule



Liquid Vial

V



Lyo Vial

In process control

LFC, P, V

DP in process control

- **Using positive samples (capillaries, laser drilled holes, cracks)**
 - ☹️ costly
 - ☹️ time consuming
 - 😊 most similar to negative samples (for method development)
- **Determining the measuring capability of a machine: needle valve**
 - 😊 Adjustable orifice
 - 😊 Set-up for a defined leak rate
 - 😊 Installation on every chamber
 - 😊 Manual or automated activation for process control
- **Advantages**
 - 😊 Leak rate reproducible, quickly qualified by flowmeter
 - 😊 No big amounts of prepared samples needed
 - 😊 Automated testing to challenge functionality of stations

Comparing Physical Container Closure Integrity Test Methods and Artificial Leak Methodologies;
S. Pelaez, M. Kahl, R. Mattes et al.; PDA Journal of Pharmaceutical Science and Technology; 2019

Applications

From lab scale to inline systems

Lab scale – NEO DPX

Key Benefits

- Multiple formats: vials, syringes, ampules
- All three DP tests included
- Improved sensitivity of the DP measurement technology, down to 1.1 μm
- recipe management system

Trends

- many formats
- enhanced sensitivity
- simple format changeover
- development of recipes by enduser



Lab scale – NEO DPX – Format change



Lab scale – NEO DPX – Format change



Thank you!