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Reduction of Fugitive Emissions – New TA Luft Requirements

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Content

Tightness Demands

IED directive [2010/75/EC]

Industrial **E**mission **D**irective

- energy industries (incl. oil & gas refineries)
- production and processing of metals
- mineral industries
- chemical industry
- waste management
- other activities (e.g. pulp & paper industry)

- prevent / reduce emissions to air, water and land
- reduce generation of waste
- use energy efficiently
- prevent accidents

use **B**est
Available
Technology
to achieve objectives

Fugitive Emission Standards

International Standard

- **EN ISO 15848-1 (2015)**

  Industrial valves - Measurement, test and qualification procedures for fugitive emissions - Part 1: Classification system and qualification procedures for type testing of valves

American Standards

- **API 622 (2018)**

  Type testing of process valve packing for fugitive emissions

- **API 624 (2014)**

  Type testing of rising stem valves equipped with graphite packing for fugitive emissions

- **API 641 (2016)**

  Type testing of quarter-turn valves for fugitive emissions

German Legislation

TA-Luft (1986/2002)
(general regulations with details regarding BFC and stuffing box packings)

VDI 2440 (2000)
(emission control/reduction in mineral oil refineries)

stuffing box packings:
use metallic bellows
or
limit the emission of packing materials under operational conditions in a first-time test:
10-4 mbar*l/m/s (T ! 250 °C)
10-2 mbar*l/m/s (T > 250 °C)

New TA Luft Regulation

Reference to EN ISO 15848-1

- **no first-time test for packing material** according to **VDI 2440** (2000) is required anymore

- **valve** has to be classified according to **EN ISO 15848-1**
  - **temperature class**
  - **endurance class**
  - **tightness class**

	p ≤ 40 bar	p > 40 bar
T ≤ 200 °C	BH	CH
T > 200 °C	CH	CH 1)

1) to be aimed

Tightness Demands for Helium

	test medium: Helium	p ≤ 40 bar	p > 40 bar
T ≤ 200 °C	**stem seal**	≤ 10-4 mg/m/s	≤ 10-2 mg/m/s
	body seal	≤ 50 ppmv	≤ 50 ppmv
T > 200 °C	**stem seal**	≤ 10-2 mg/m/s	≤ 10-2 mg/m/s 1)
	body seal	≤ 50 ppmv	≤ 50 ppmv

1) to be aimed

Comparison of Test Standards

Test item

Scope

Test parameters

Specimen size

Assembly

Test duration

Mechanical cycles

Temperature cycles

Test pressure

Test medium

Tightness requirements

Re-adjustment of the bolt load

Test Item and Scope

	Test Item	Scope
VDI 2440	packing	qualification test as a "high-grade sealing system"
API 622	packing	packing performance - fugitive emission - corrosion test - material composition and properties (weight loss, density, lubricant content, leachables)
API 624	valve (packing and body seal)	fugitive emission type testing of valves with packings tested according to API 622
API 641	quarter-turn valves (packing and body seal)	fugitive emission type testing of quarter-turn valves with packings tested according to API 622
ISO 15848-1	valve (packing and body seal)	classification of the performance of industrial valves ("endurance classes") - CO1, CO2, CO3 (on-off valves) - CC1, CC2, CC3 (control valves)

Test Parameters and Specimen Size

	Parameters	Specimen Size
VDI 2440	prestress value assembly procedure stem cycles temperature pressure	individually
API 622	prestress value	1.5 x 1.0 in. (38.1 x 25.4 mm)
API 624	prestress value assembly procedure	individually (specified in Annex B)
API 641	prestress value assembly procedure	individually max. NPS24 oder ASME B16.34 class 1500
ISO 15848-1	stem cycles temperature pressure	individually

Mechanical and Temperature Cycles

	Mechanical cycles	Temperature cycles
VDI 2440	individually typical: 500 - 2000 rate: 2 mm/s (only at elevated temperature)	only heating-up to test temperature two levels: < 250 °C, ≥ 250 °C
API 622	1510 (300 per day) rate: 0.12 - 0.2 in./s (3 - 5 mm/s) stroke: 4 in. (102 mm) 50% at RT, 50% at T	5 (1 per day) 500 °F (260 °C)
API 624	310 50% at RT, 50% at T	3 500 °F (260 °C) 1 cycle to -20 °F (-29 °C) optional
API 641	610 50% at RT, 50% at T	3 500 °F (260 °C) or less
ISO 15848-1	- 205, 1500, 2500 (CO1-CO3) - 20000, 60000, 100000 (CC1-CC3) rate 1 - 5 mm/s 50% at RT, 50% at T	2 (CO1/CC1) 3 (CO2/CC2) 4 (CO3/CC3) "temperature classes": -196 °C, -46 °C, RT, 200 °C, 400 °C

Leakage Measurement

	Test medium	Test pressure	Leakage measurement
VDI 2440	Helium	individually typical: 40 bar (580 psi)	pressurization and leakage measurement after stem cycles
API 622	Methane	600 psi (41.4 bar)	pressure relief before cooling down; leakage measurement after every 50 stem cycles
API 624	Methane	max. 600 psi (41.4 bar) in dependence of the material (p/T-rating)	pressurization at the beginning; leakage measurement prior and during every 50 stem cycles
API 641	Methane	min. 100 psi (6.89 bar) max. 600 psi (41.4 bar) in dependence of the material (p/T-rating) pressure relief during temperature changes	pressurization at the beginning; leakage measurement prior and during every 100 stem cycles
ISO 15848-1	Helium or Methane	according to p/T-rating of the shell material in every test step (body seal only at the end of each endurance class)	according to p/T-rating of the shell material in every test step (body seal only at the end of each endurance class)

Tightness Requirements

	Tightness requirements	Re-adjustment
VDI 2440	< 250 °C: 1.0E-04 mbar*l/(s*m) ≥ 250 °C: 1.0E-02 mbar*l/(s*m)	no
API 622	not specified	yes 1 re-adjustment (if leak rate exceed manufacturer´s maximum allowable leak rate)
API 624	100 ppmv	no
API 641	100 ppmv	no
ISO 15848-1	"Tightness Classes" for packing: A: ≤ 1.0E-05 mg/(s*m); ≤ 50 ppmv B: ≤ 1.0E-04 mg/(s*m); ≤ 100 ppmv C: ≤ 1.0E-02 mg/(s*m); ≤ 500 ppmv Body seals: ≤ 50 ppmv; ≤ 50 ppmv Helium / Methane	yes 1 for CO1/CC1 2 for CO2/CC2 3 for CO3/CC3

Test Rig for VDI 2440 and API 622

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stb.freak

Leakage Measurement (Vacuum Method)

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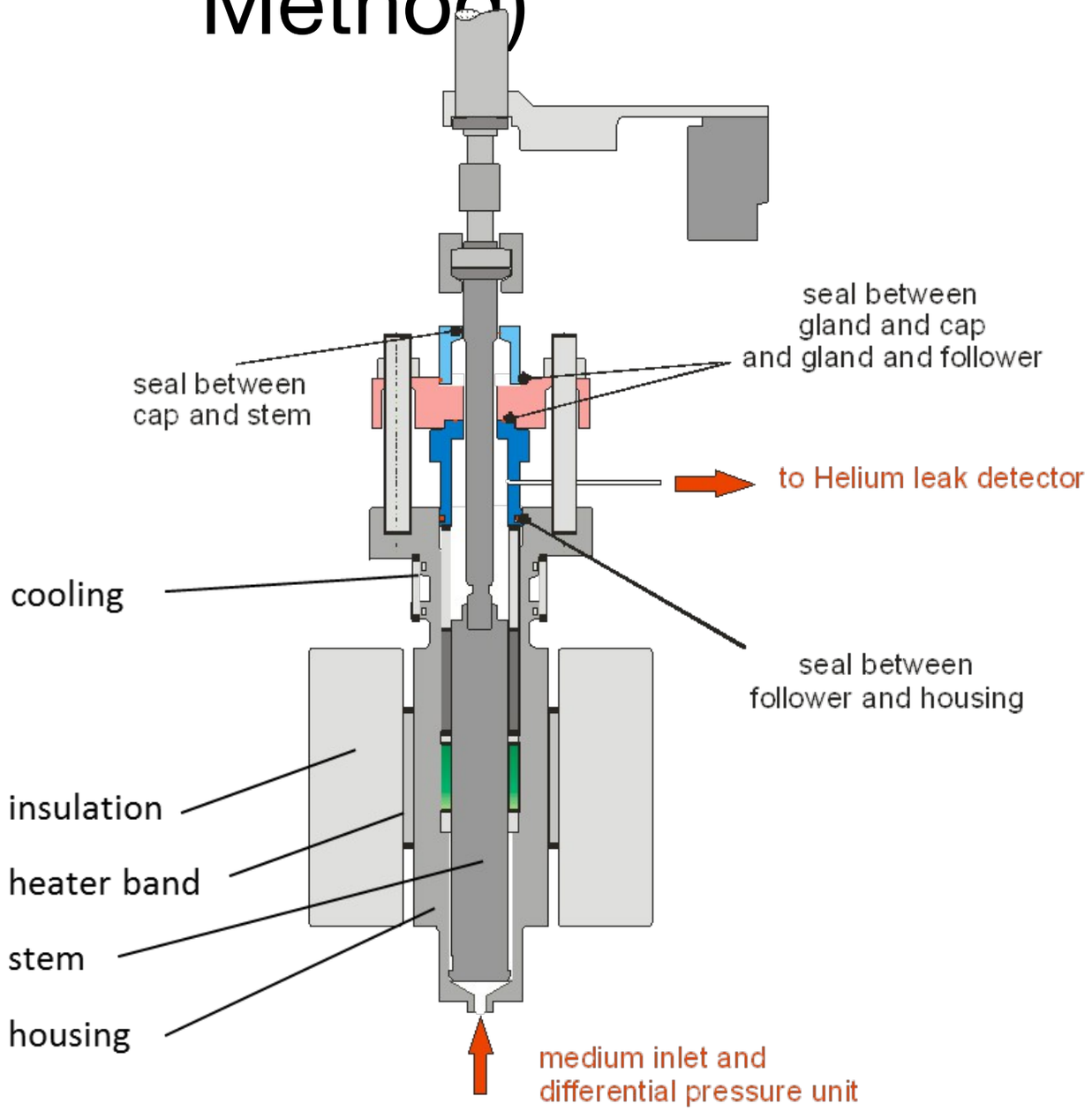

Leakage Measurement (Sniffing Method)

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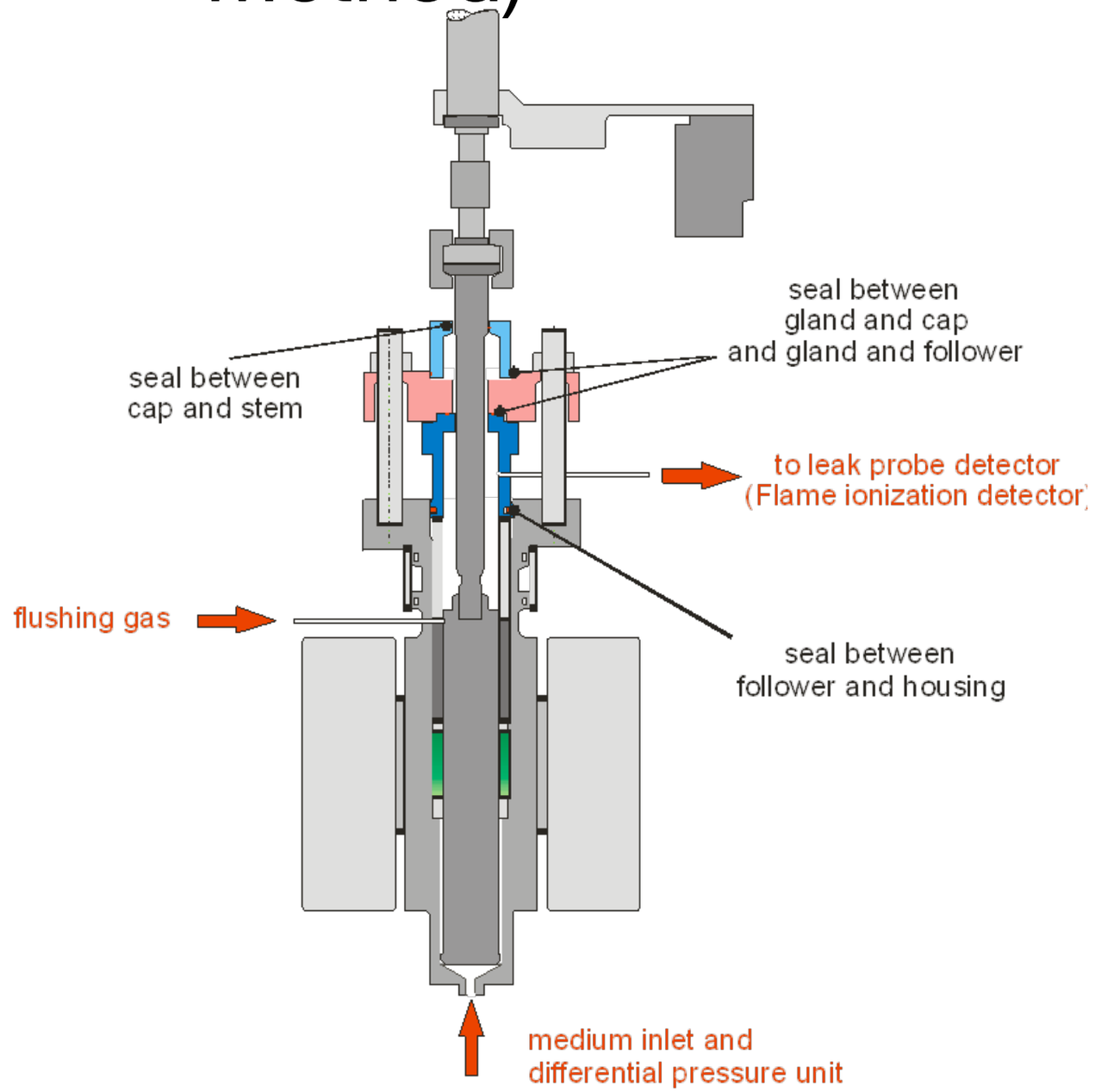

Test Rig for API 624, API 641 and EN ISO 15848-1

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Technical Specification:

Valve Size:	max. DN150/PN250 or DN250/PN25
Temperature:	max. 400 °C
Pressure:	max. 200 bar
Test Medium:	He, N2, CH4
Clamping Load:	max. 1450 kN
Actuator:	max. 250 Nm

Schematic View

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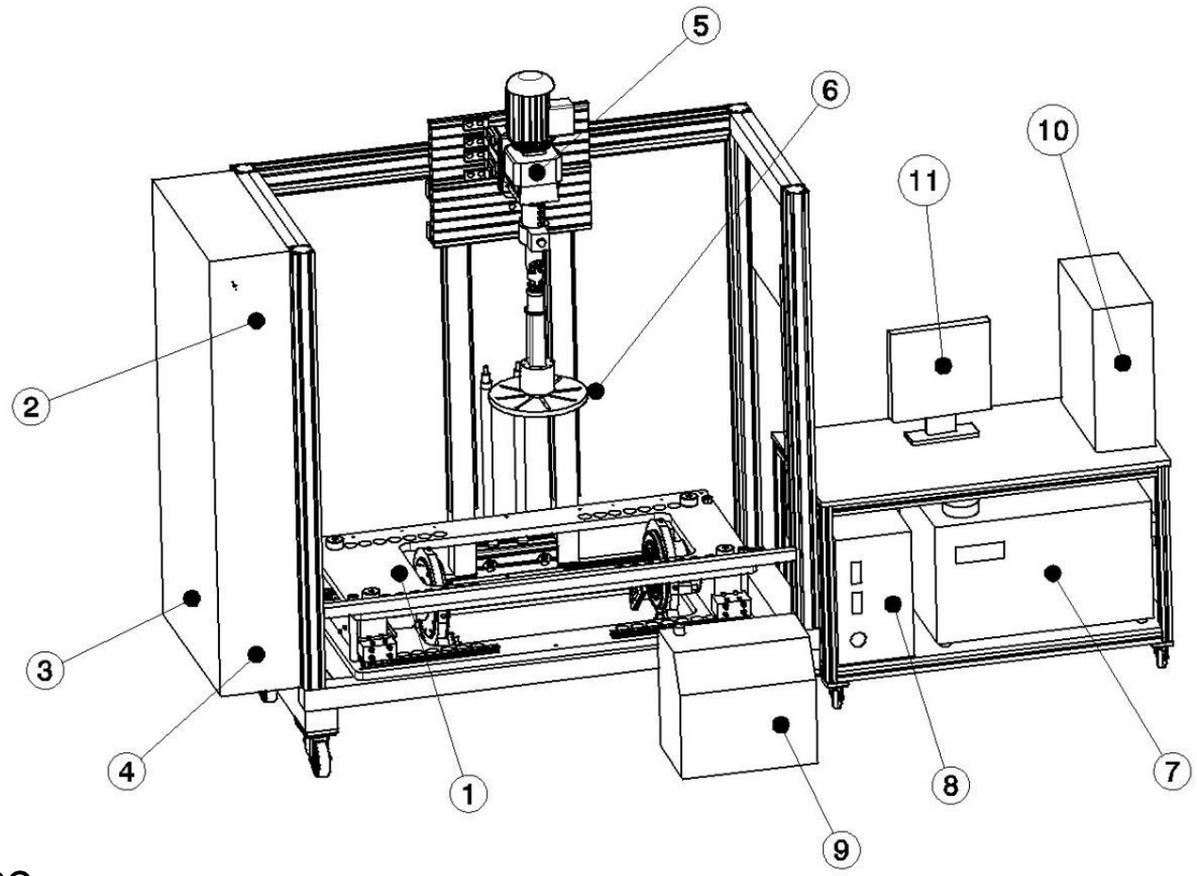
valve.teq



1 Tensioning device
2 Instrumentation and Control cabinet
3 Hydraulic unit
4 Leakage unit
5 Actuator
6 Clutch
7 Cooling unit
8 Heating unit
9 Leak detector
10 PC
11 Monitor

Leakage Measurement (Vacuum and Sniffing Method)

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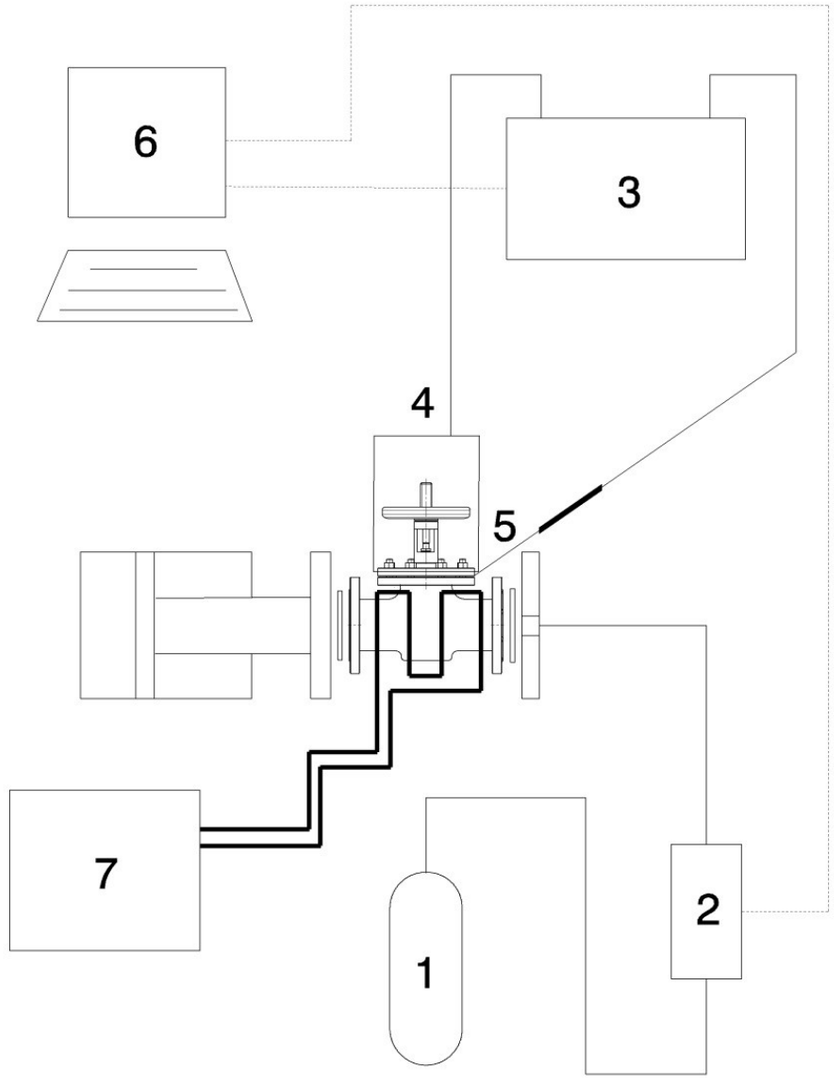
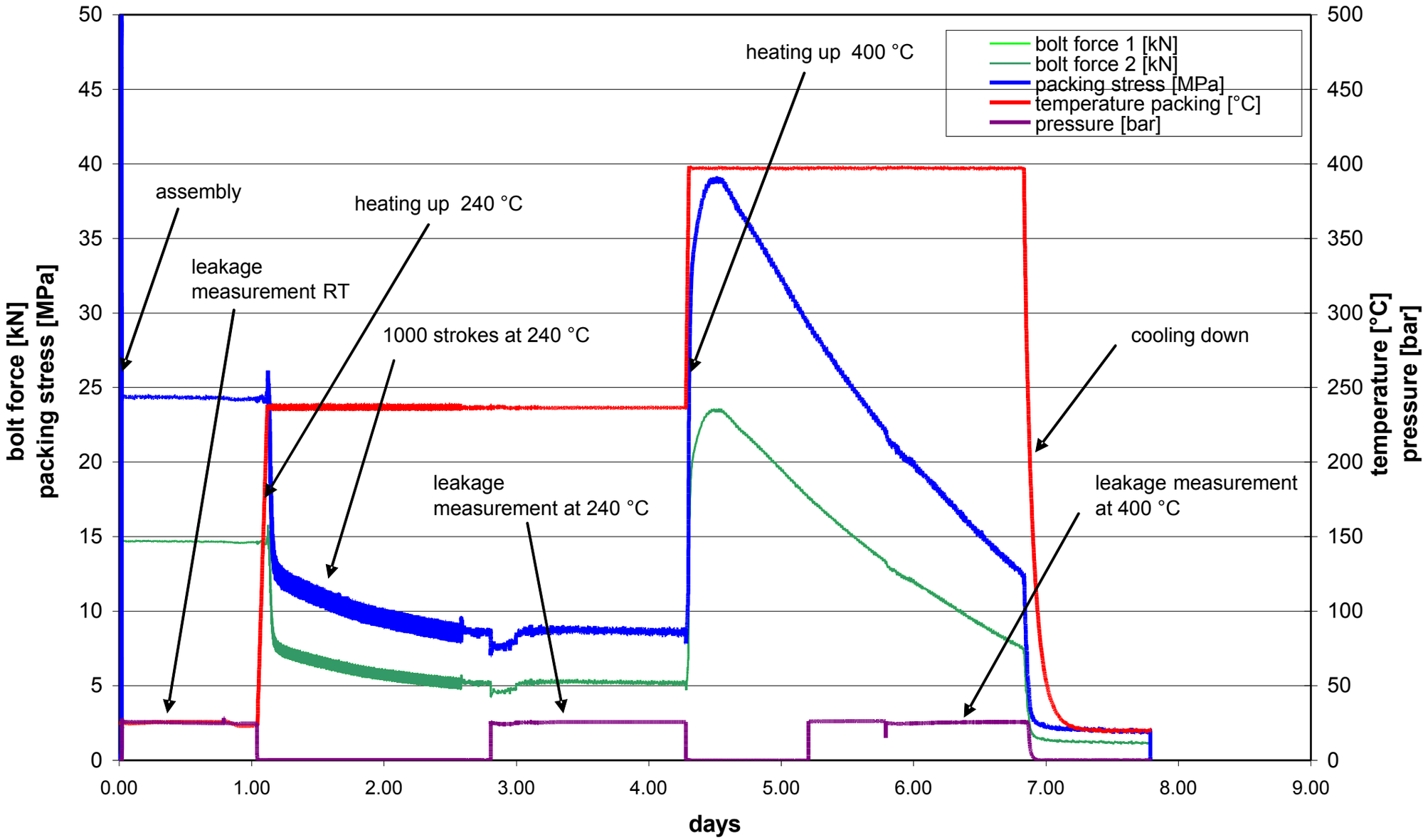
valve.teq

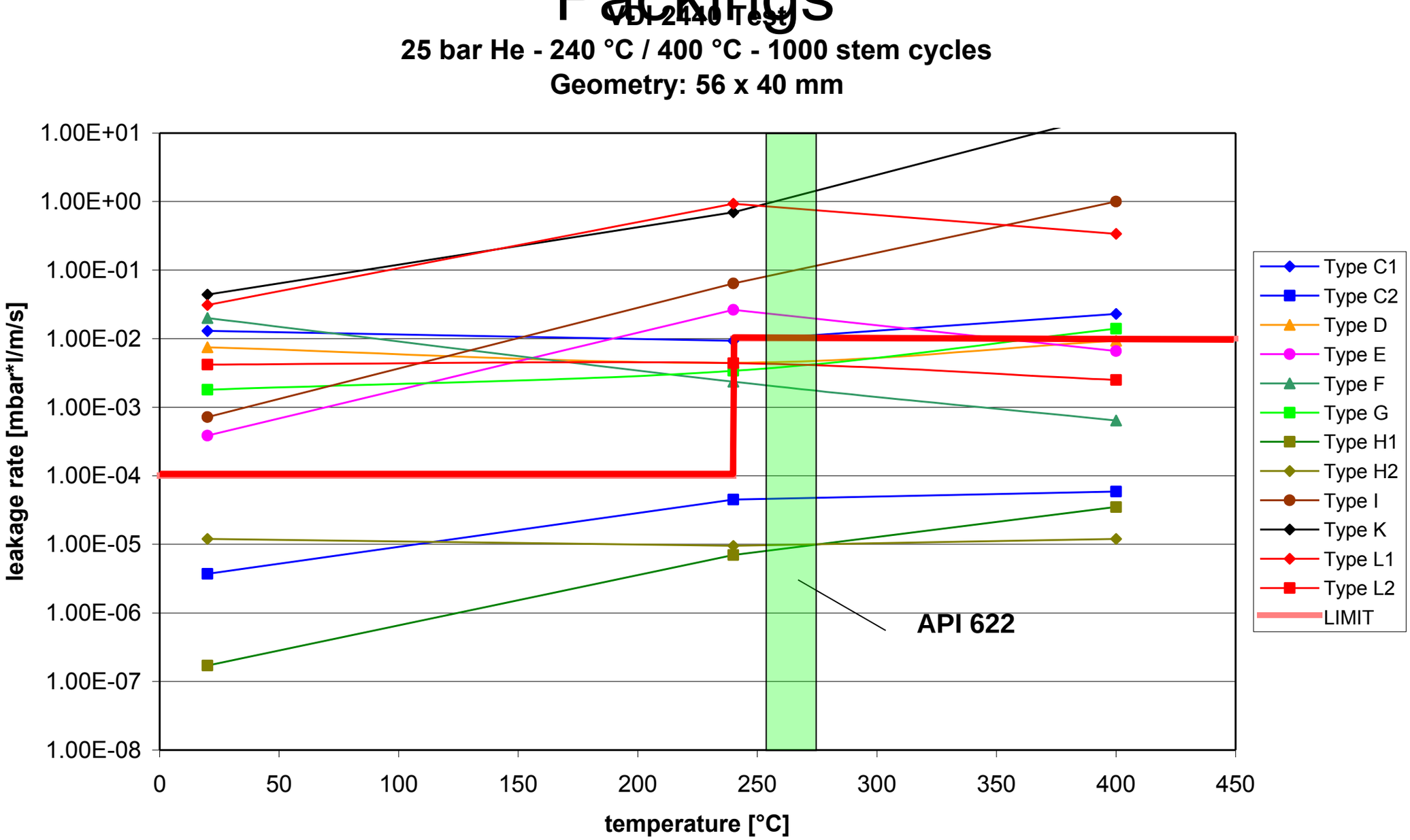


1 Gas medium
2 Leakage unit
3 Leak detector
4 Vacuum chamber
5 Sniffing line
6 Data acquisition
7 Heating unit

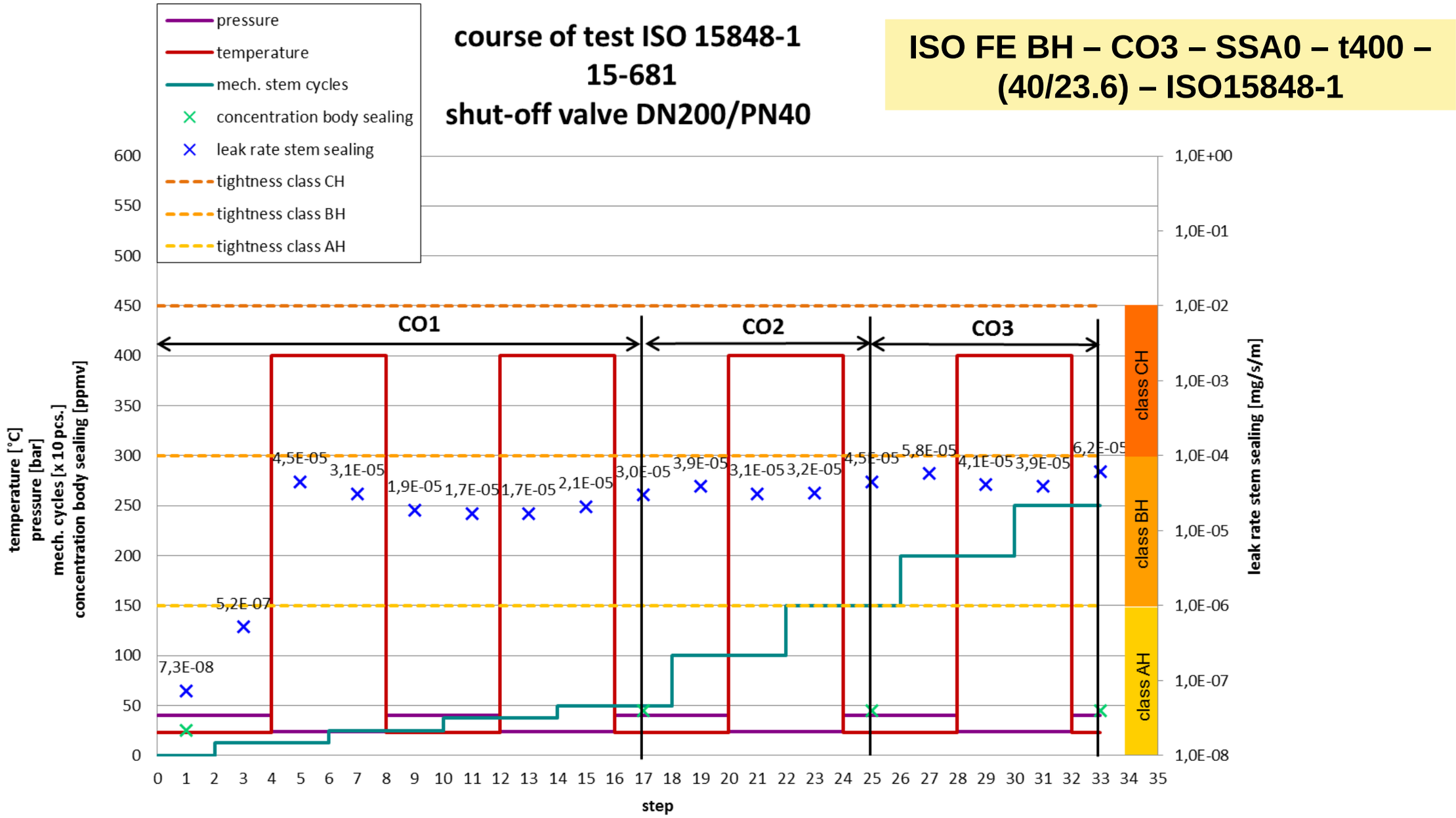
Typical Test Result VDI 2440



Test Results of different Set of Packings

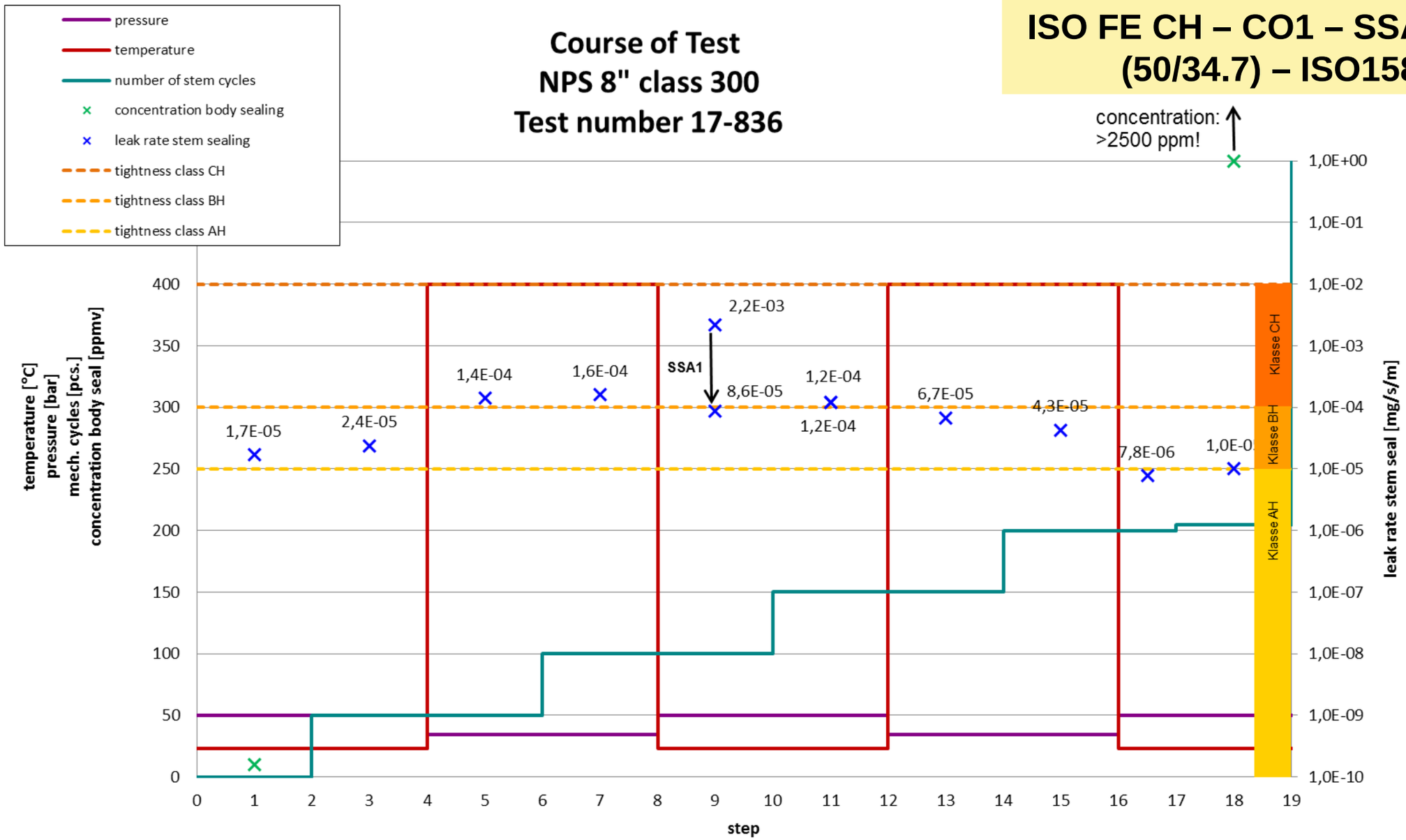


Test Result Shut-Off Valve ISO 15848-1



Test Result Shut-Off Valve ISO 15848-1

ISO FE CH – CO1 – SSA1 – t400 – (50/34.7) – ISO15848-1



Reduction of Fugitive Emissions

Selection of proper gasket material for cover seal

Selection of proper packing material / set of packing

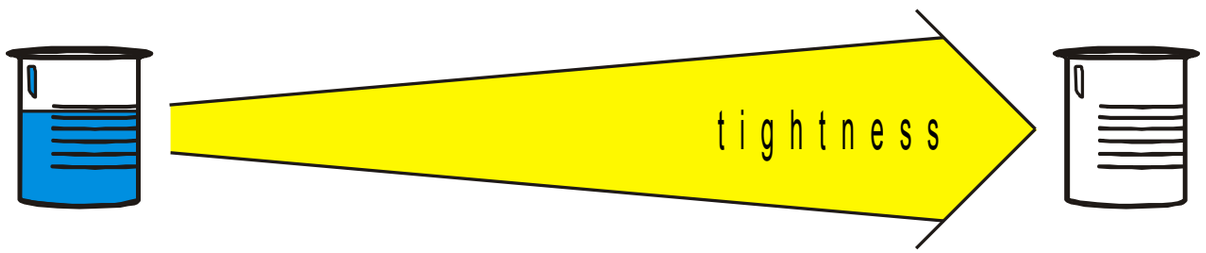
Optimization of stem and housing surfaces

Optimization of stem, housing and gland follower dimensions/tolerances

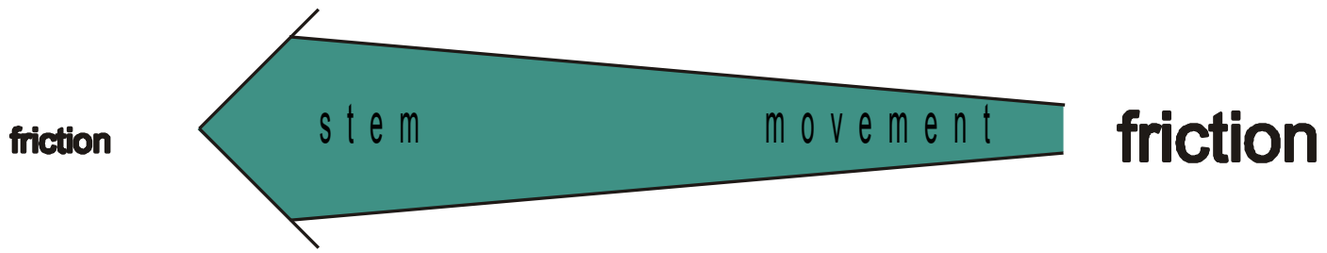
Assembly procedure of packing materials

Use of hydraulic tensioners for assembly of set of packings

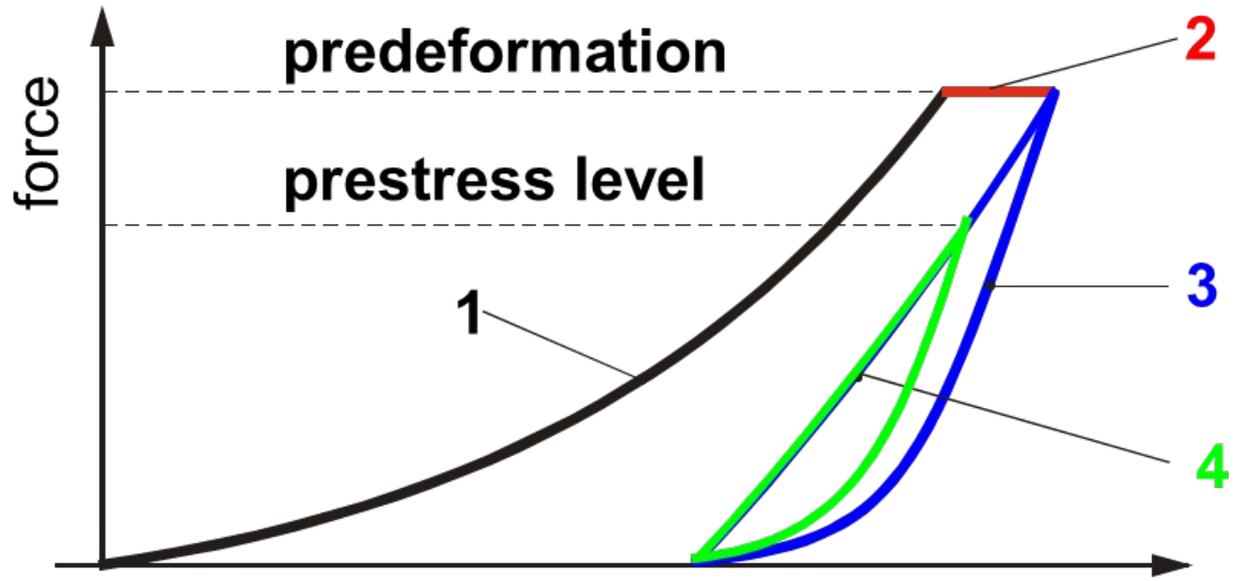
Friction vs. Tightness



l o prestress w h i



Predeformation and Prestressing of Packings



1 predeformation
(seating of rings, filling of gaps)

2 dwell time (plastic deformation)

3 reproducable (un)-loading curve

4 prestressing

Use of Hydraulic Tensioners

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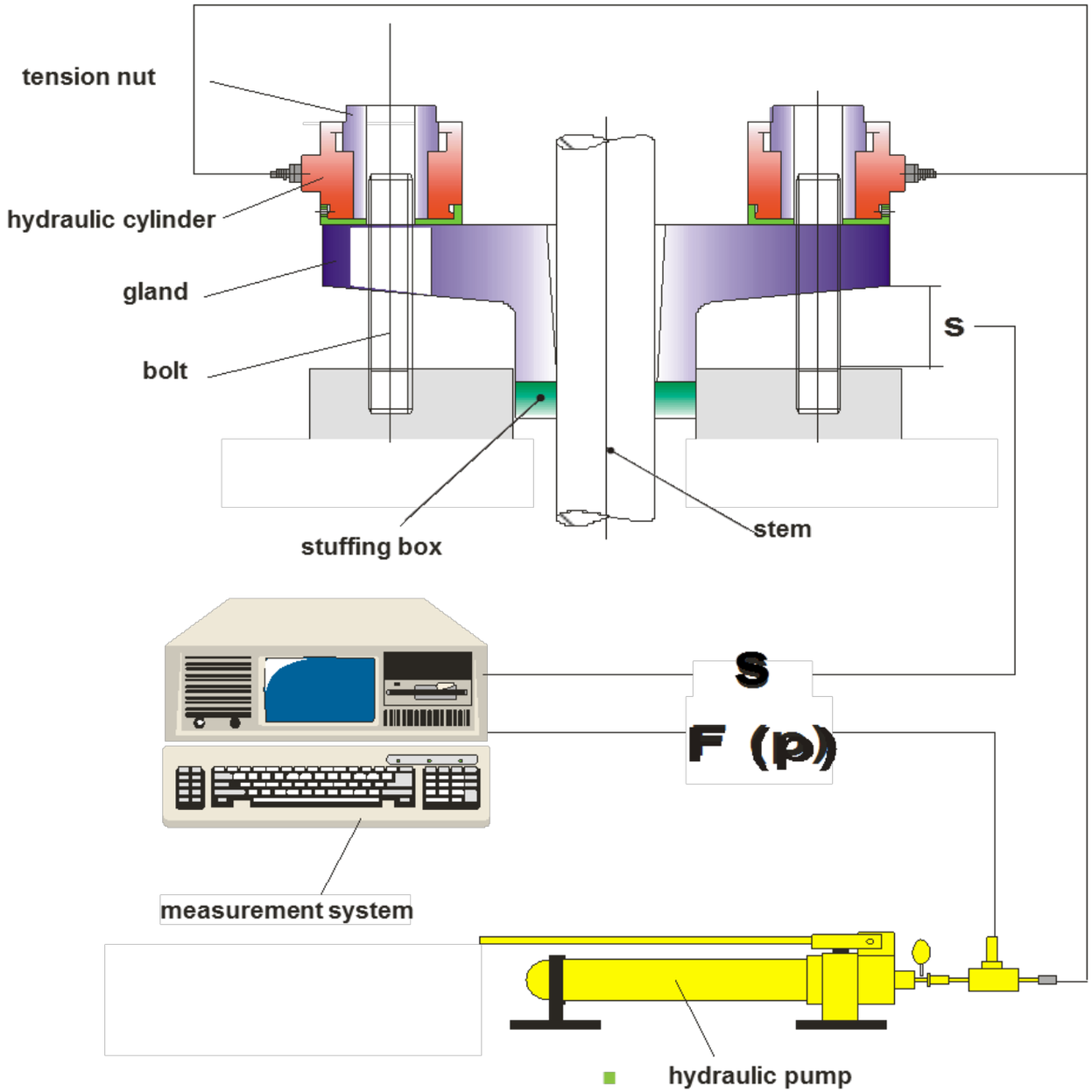
- deformation controlled



Mounting Tools for Stuffing Box Packings

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Summary (1)

The test procedures in VDI 2440 and API 622 enable a qualification of packing materials.

Leakage rates of Helium (VDI 2440) and Methane (API 622) are in the same order of magnitude, the results are comparable. But the measurement technique for Methane has some limits.

The test procedures in ISO 15848-1, API 624 and API 641 enable type testing of valves.

While API 624 and API 641 have only one acceptance criteria for defined test conditions, ISO 15848 provides a classification in respect of mechanical cycles, temperature range and tightness classes.

Summary (2)

ISO 15848-1 will become the test basis for the use of valves within the scope of TA Luft.

ISO 15848-1 allows tests with helium or with methane; this will (probably) also be accepted in TA Luft, but with the same limit values.

ISO 15848-1 distinguishes between temperature classes. TA Luft requires testing only at design temperature.

ISO 15848-1 distinguishes between endurance classes. TA Luft does not name an endurance class for which the tightness proof has to be provided.

Thank you!

Do you have questions?

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