# Vakuové ventily

Dělení podle různých principů

Podle funkčnosti

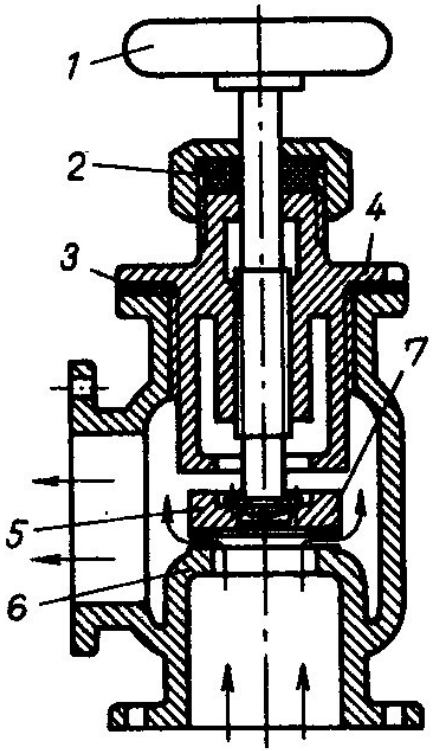
- oddělovací
- napouštěcí
- zavzdušňovací
- omezení čerpací rychlosti

Ovladání

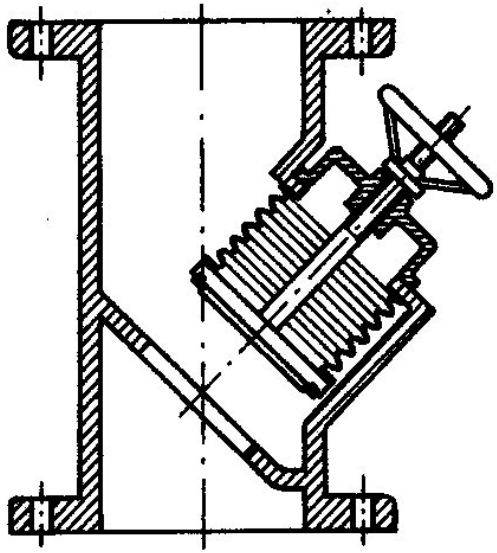
- ruční
- pneumatický
- elektromagnetický

Oblast použití

- hrubé vakuum
- HV vakuum
- UHV, XHV vakuum



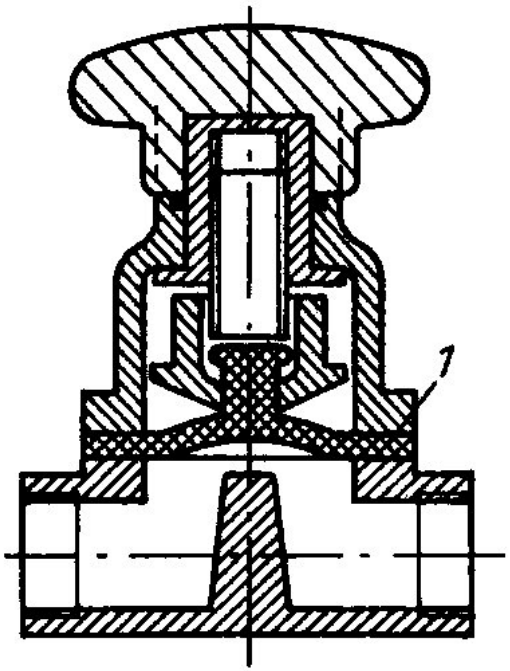

Obr. 6.27. Ventil s talířkem přitlačovaným šroubem
*1* – rukojeť; *2* – těsnění; *3* – těsnicí kroužek; *4* – horní příruba; *5* – talířek; *6* – dolní příruba; *7* – těsnění talířku



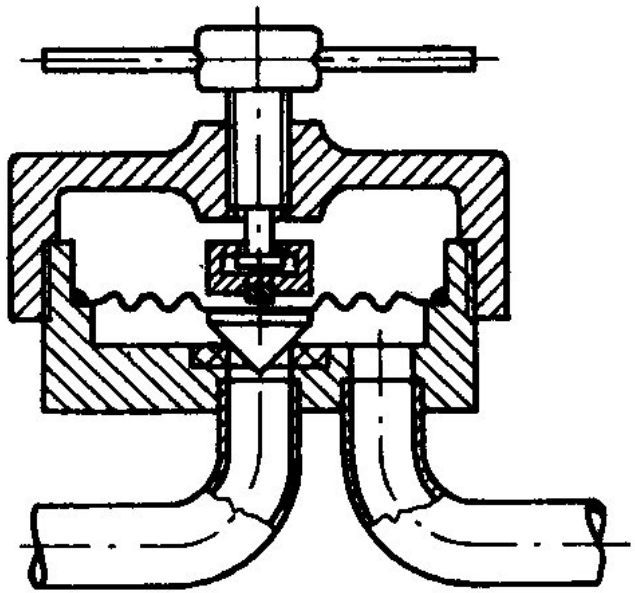
Obr. 6.28. Ventil těsněný vlnovcem

1

[1] J. Groszkowski: Technika vysokého vakua, SNTL, Praha 1981



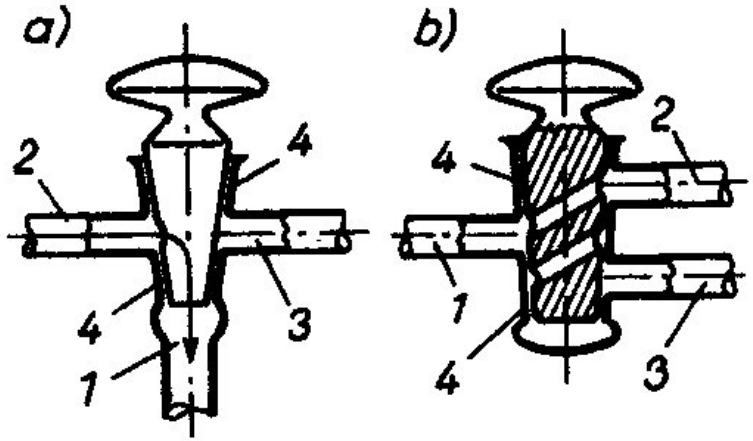

Obr. 6.32. Ventil pro nízké vakuum s membránovým těsněním (firma Leybold)

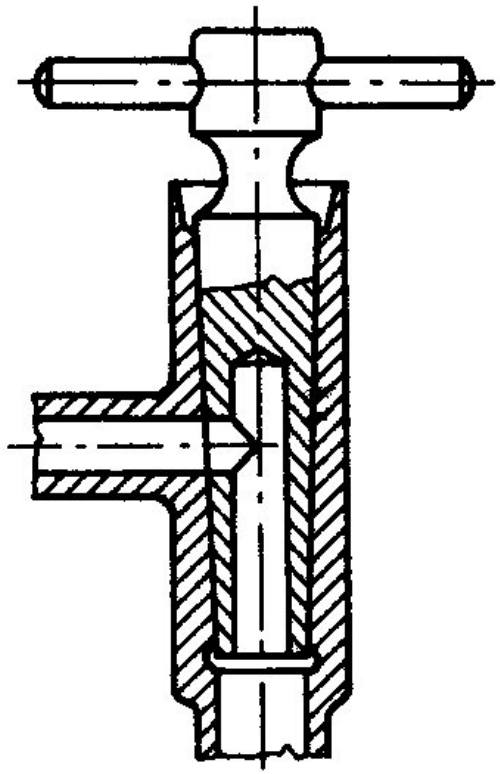


Obr. 6.33. Řez ventilu s kuželovým čepem a membránovým těsněním pro ultravysoké vakuum

2

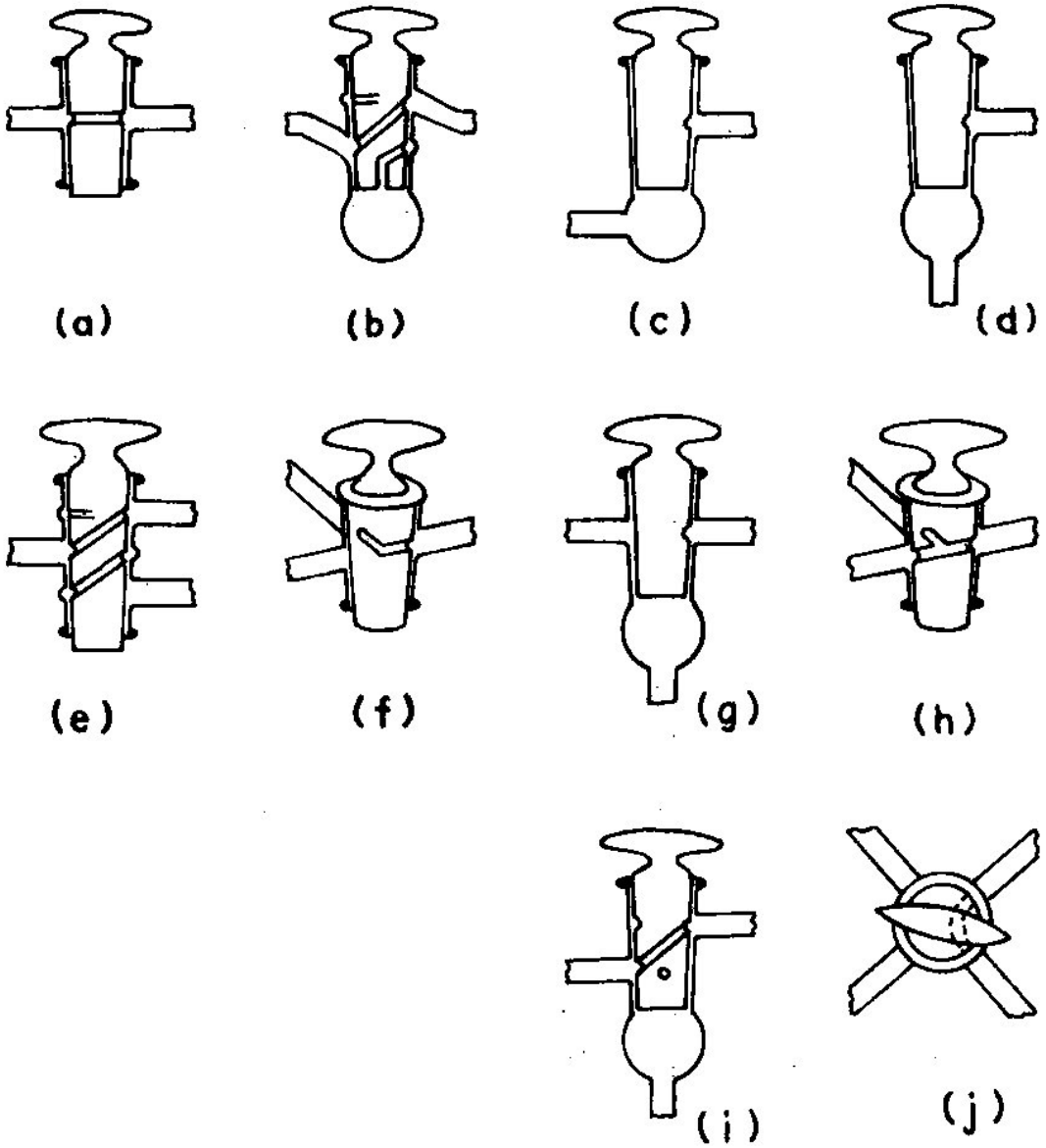
[2] J. Groszkowski: Technika vysokého vakua, SNTL, Praha 1981



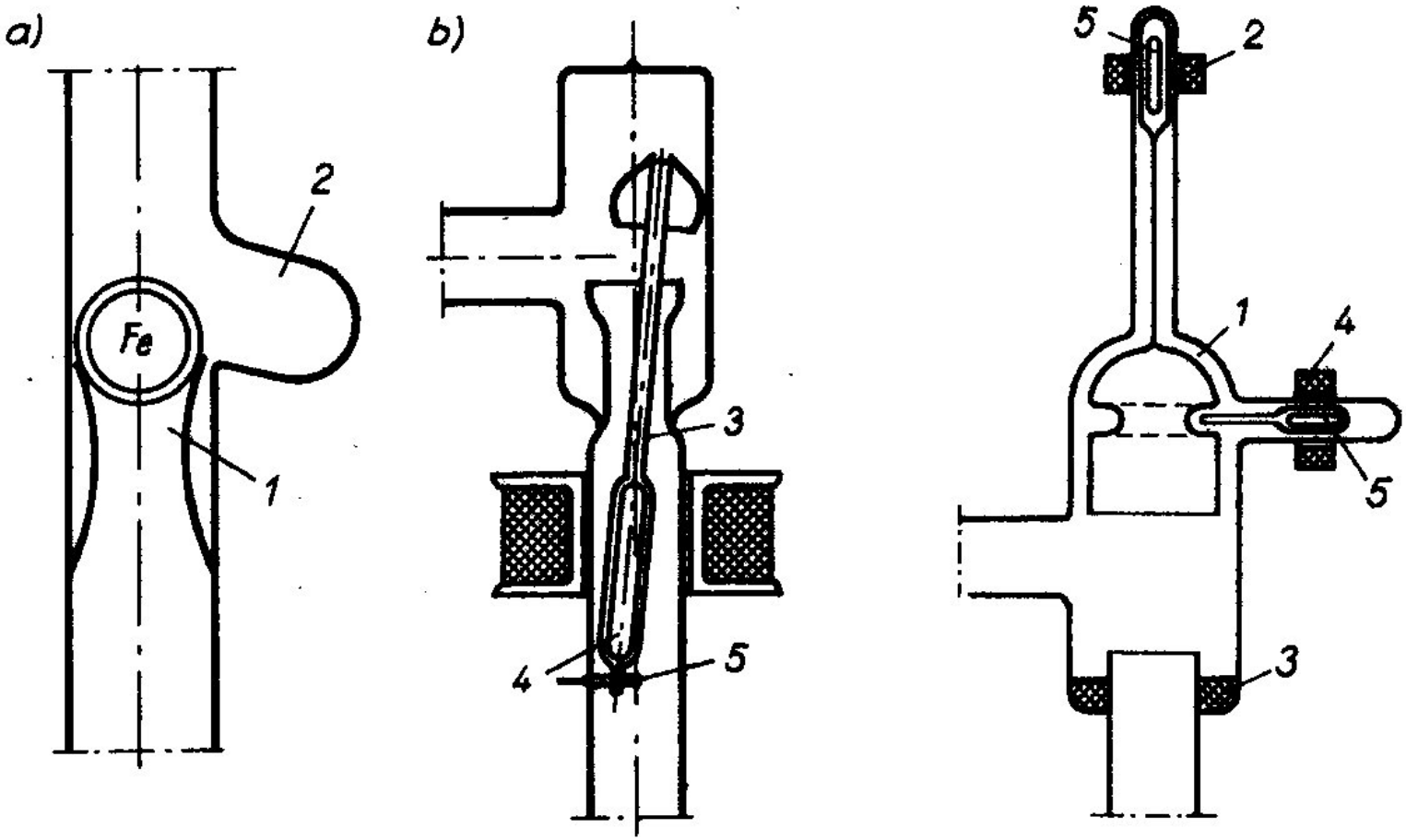
3

[3] J. Groszkowski: Technika vysokého vakua, SNTL, Praha 1981



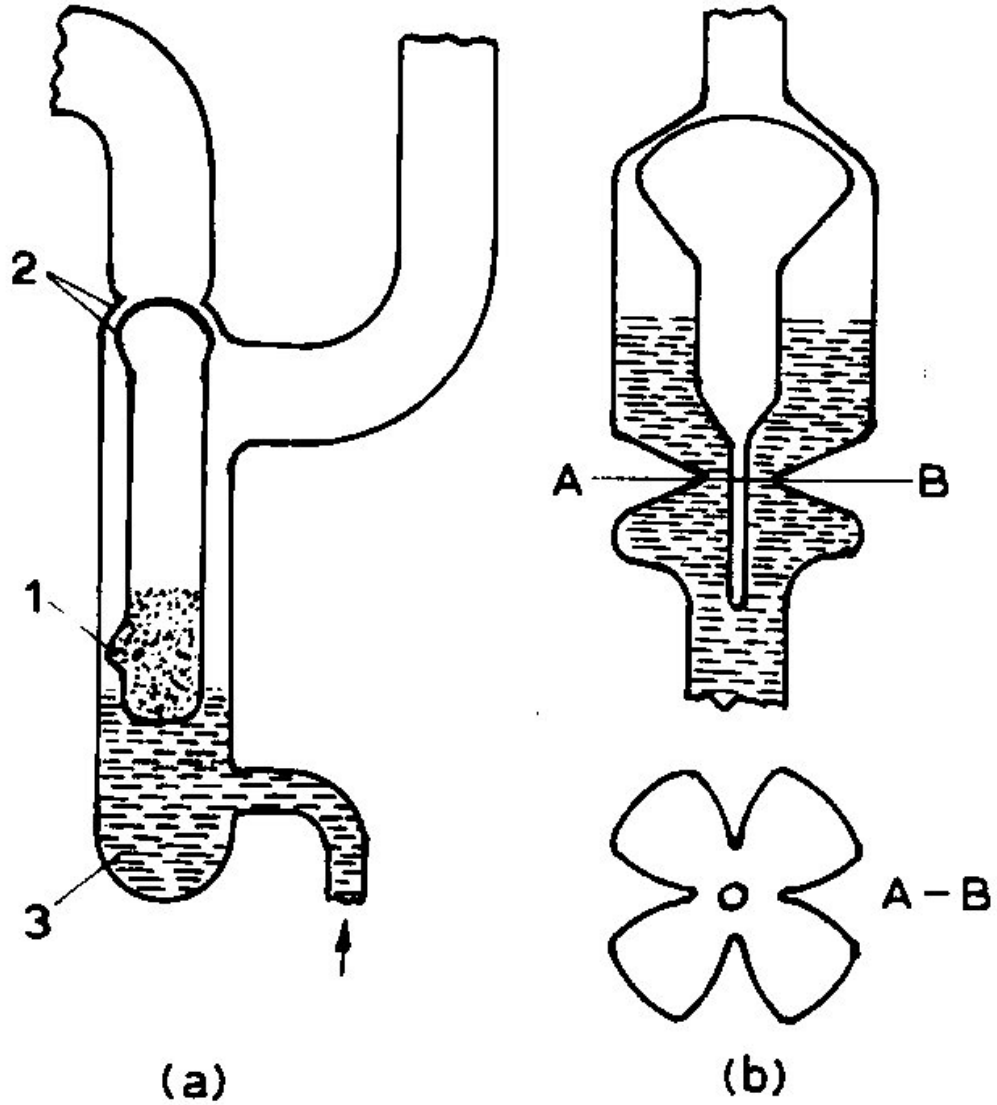

4

[4] A. Roth: Vacuum technology, Elsevier, 1990




5

[5] J. Groszkowski: Technika vysokého vakua, SNTL, Praha 1981




6

[6] A. Roth: Vacuum technology, Elsevier, 1990

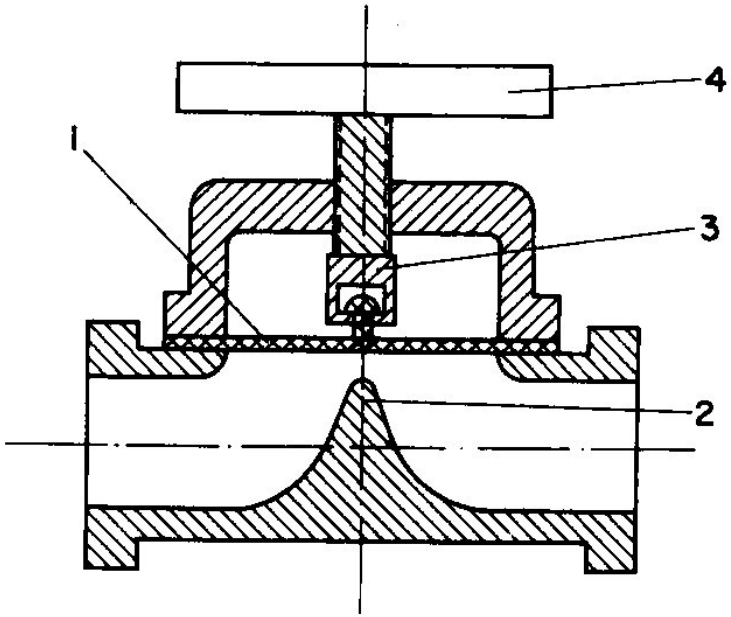
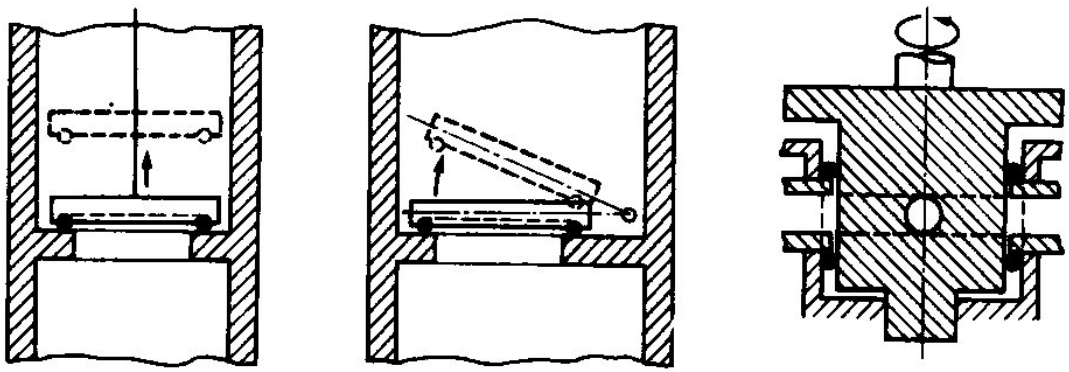
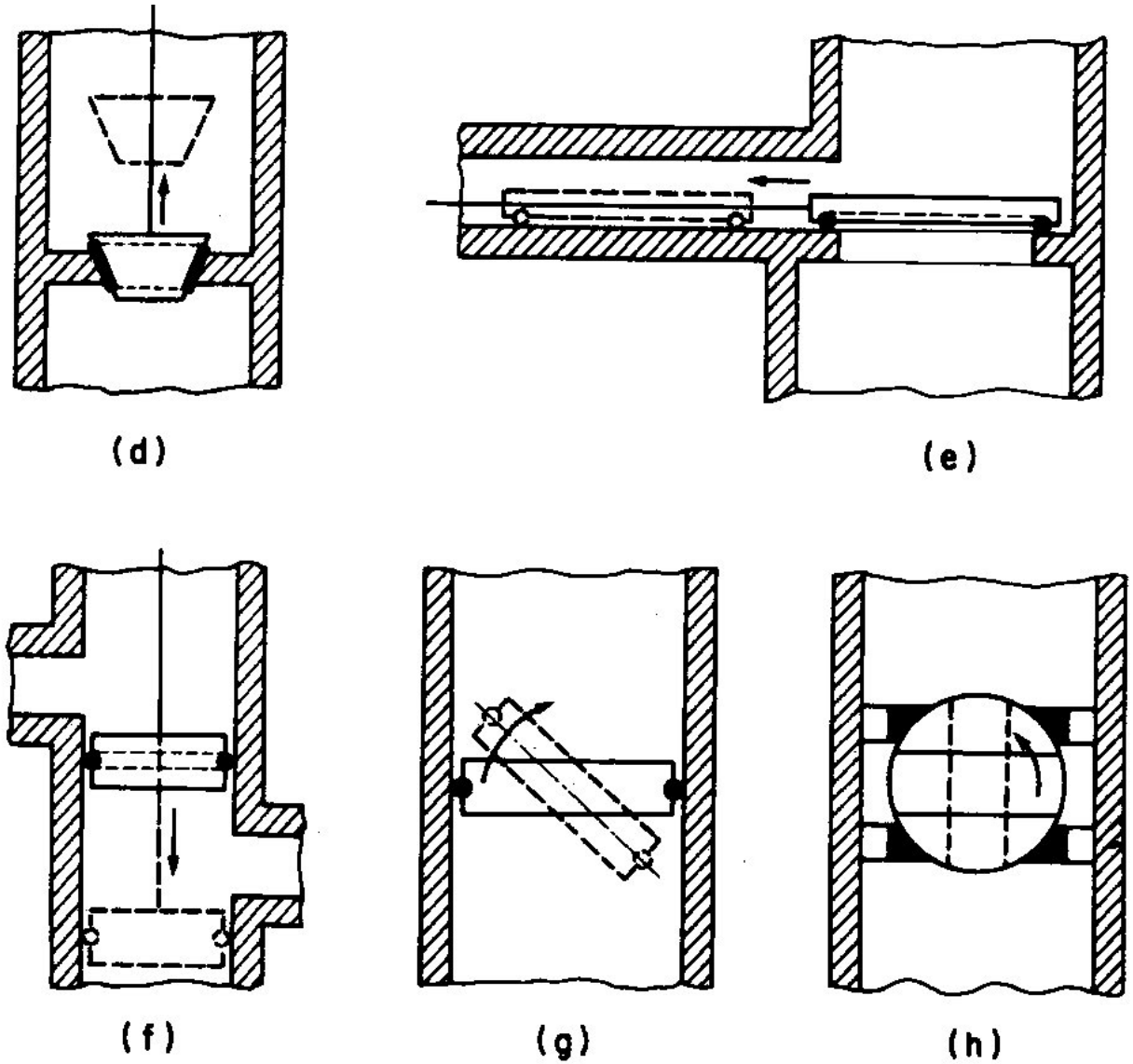



Fig. 7.61 Diaphragm valve.




7

[7] A. Roth: Vacuum technology, Elsevier, 1990




8

[8] A. Roth: Vacuum technology, Elsevier, 1990

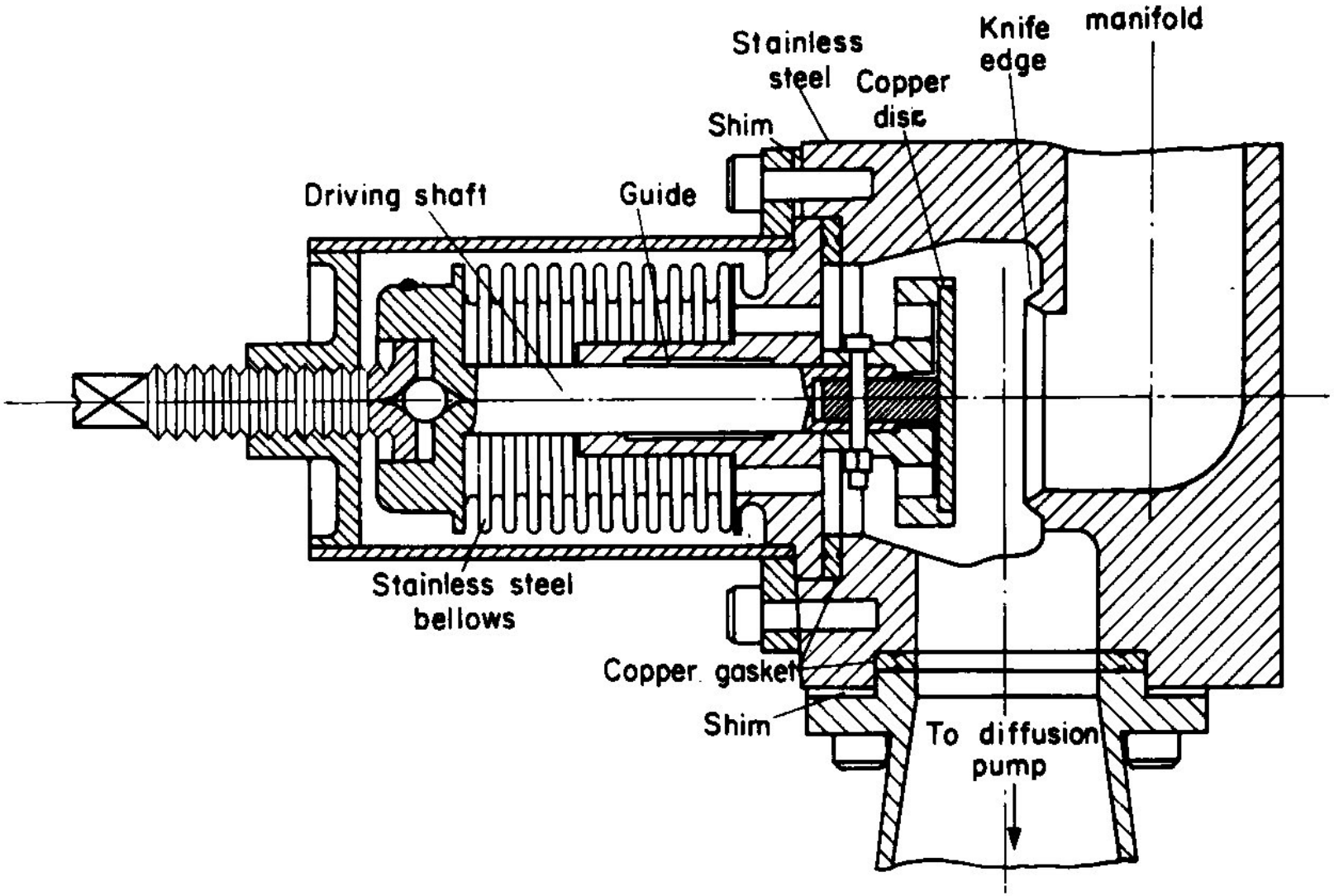



Fig. 7.65 Ultra-high vacuum valve. After Baker (1962).

9

[9] A. Roth: Vacuum technology, Elsevier, 1990

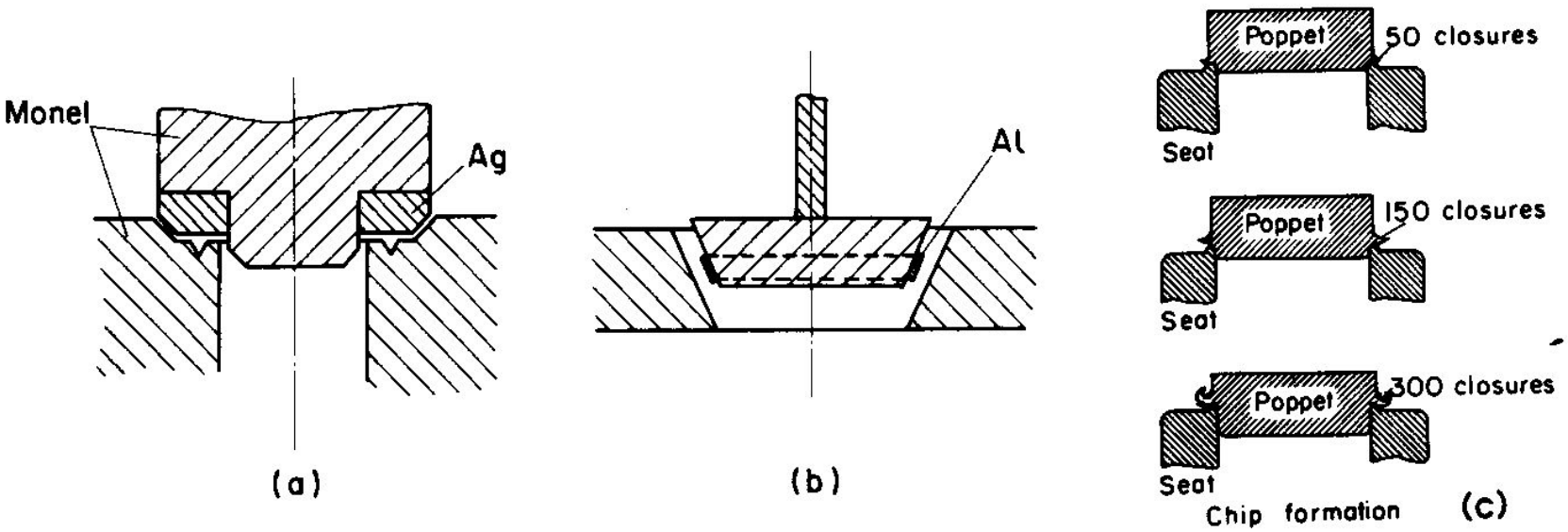
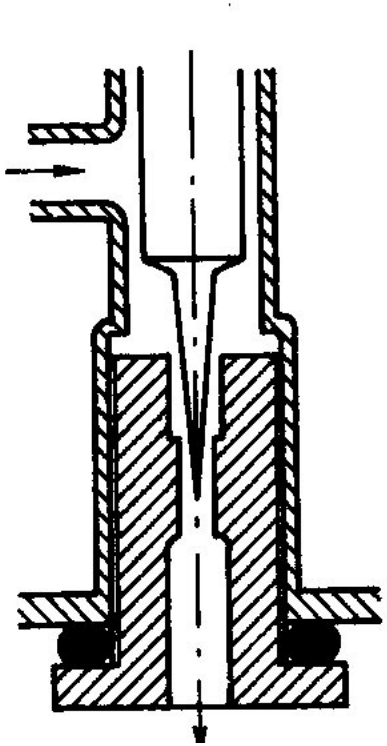


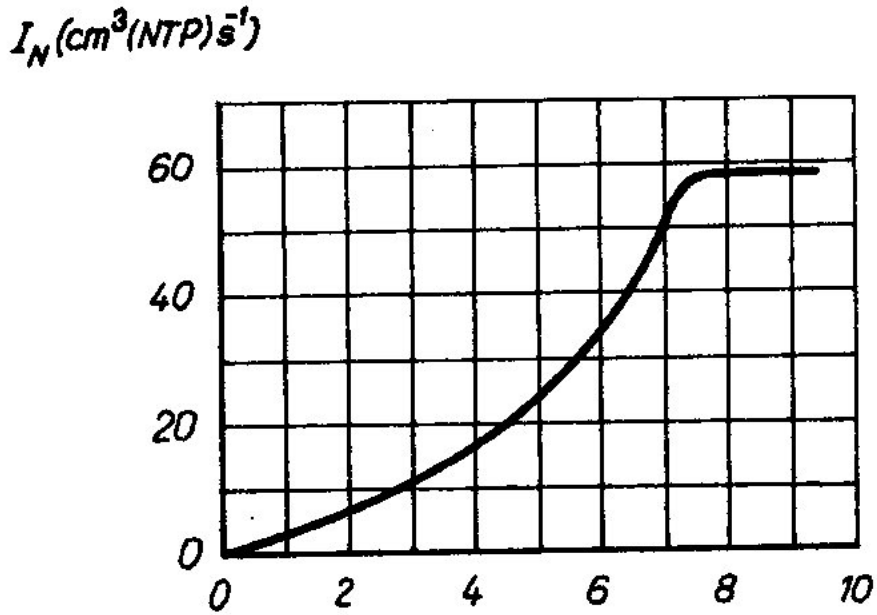

Fig. 7.63 Closing systems of all-metal valves; (a) with flat silver ring (Bills and Allen, 1955); (b) with aluminum conical ring (Kienel and Lorenz, 1960); (c) with copper poppet (Parker and Mark, 1961).

10

[10] A. Roth: Vacuum technology, Elsevier, 1990

# Jehlový ventil

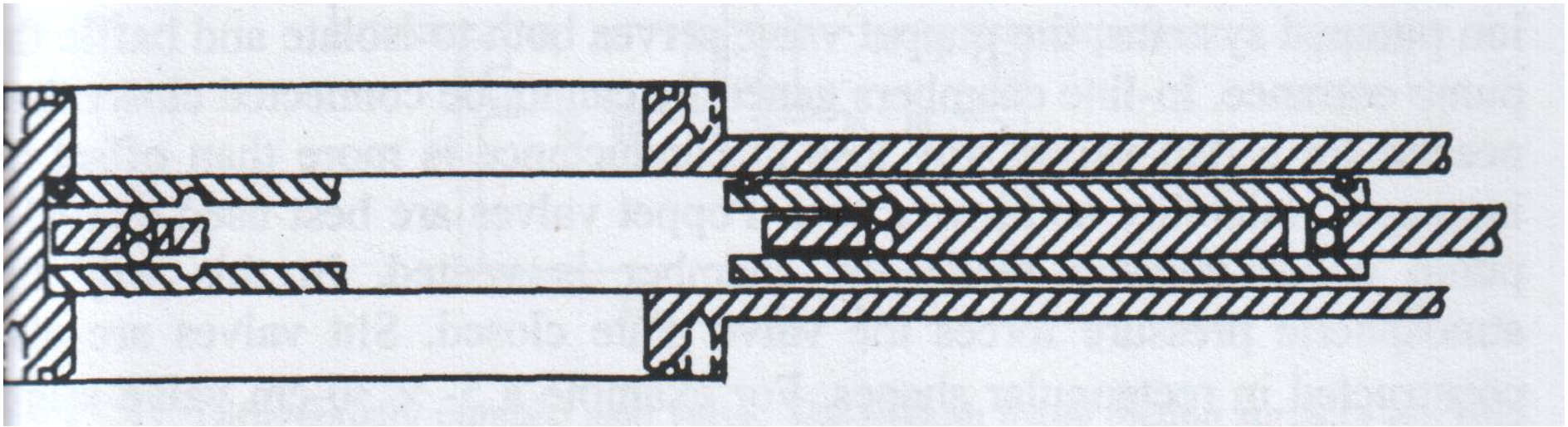





11

[11] J. Groszkowski: Technika vysokého vakua, SNTL, Praha 1981

# Deskový ventil



12

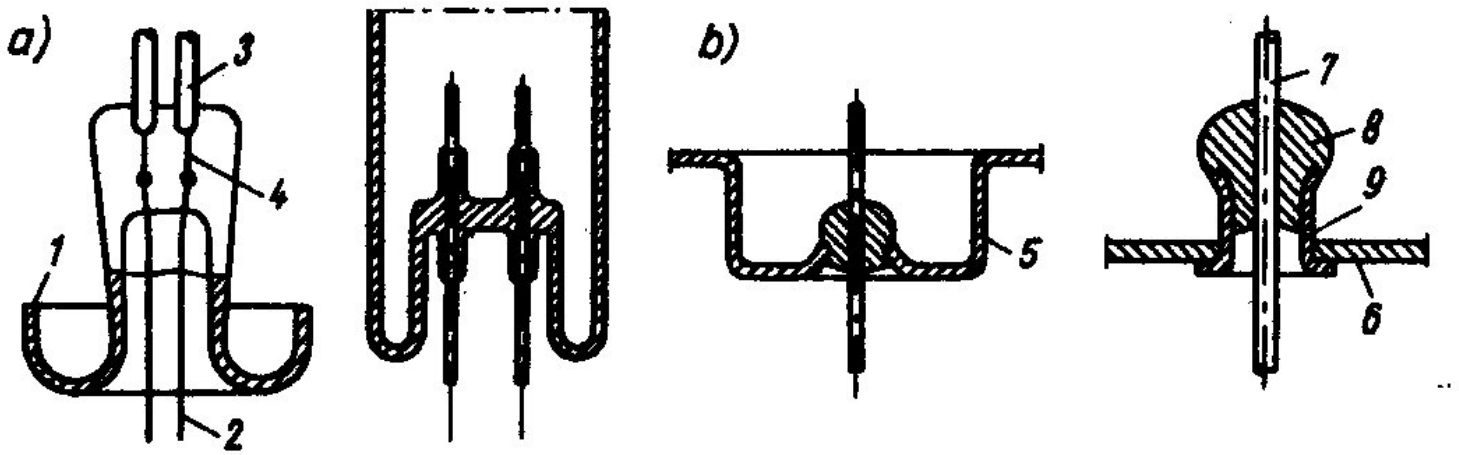
[12] F.OHanlon: A Users Gaude to Vacuum Technology, Wiley (2003)

- deskové ventily - při otevírání dif.tlak menší než $\sim$ 30 mbar
- ventily s kovovým těsněním - omezený počet cyklů
- jehlové ventily - nedotahovat silou
- zábrusové ventily - dobře namazat

# Elektrické průchodky

Vakuum v rozsahu tlaků 1-5000 Pa je velmi špatný elektrický izolant.
Průchodky vybíráme podle:

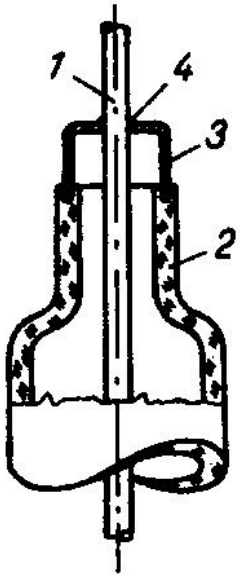
- napětí
- proudu
- frekvence



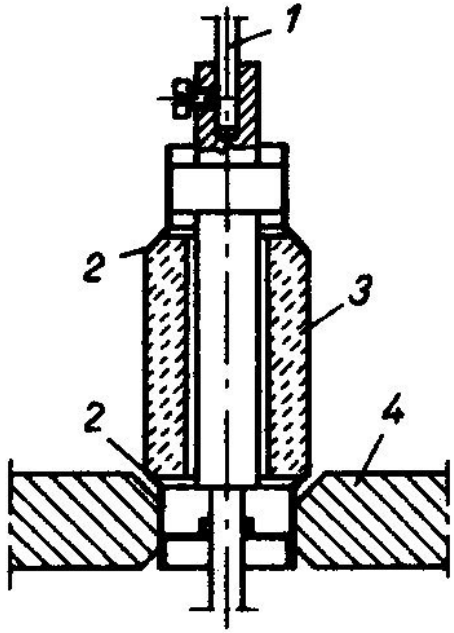

**Obr. 6.47. Elektrické průchodky pro slabé proudy**
**a) vodič z plášťového nebo platinovaného drátku zataveného ve skle, b) průtav skleněnou perličkou zatavenou do otvoru v kovové stěně**

13

[13] J. Groszkowski: Technika vysokého vakua, SNTL, Praha 1981



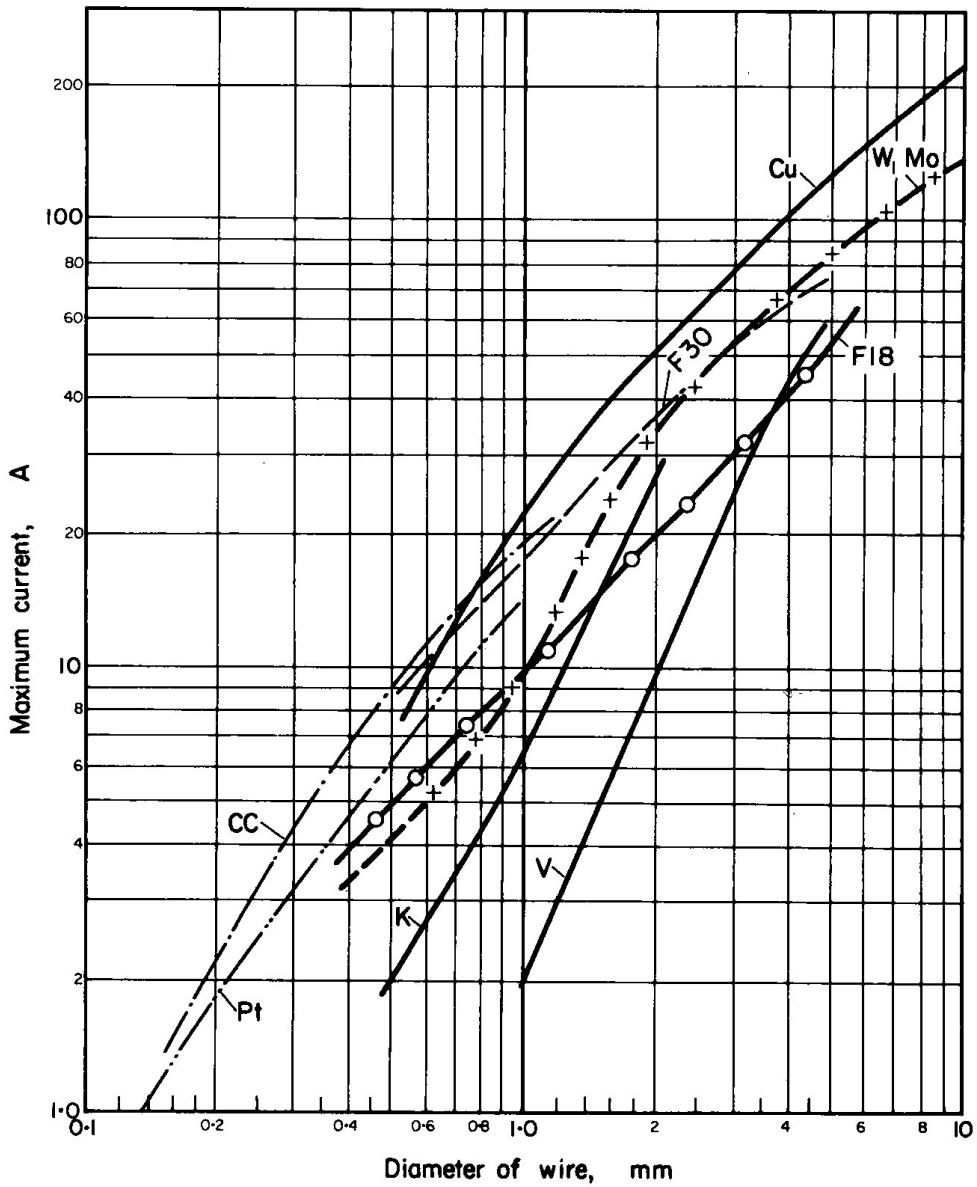

Obr. 6.48. Silnoproudá průchodka skleněnou trubicí
*1* – průtav; *2* – sklo; *3* – kovarová čepička; *4* – pájka




Obr. 6.49. Silnoproudá průchodka kovovou stěnou s keramickým izolátorem
*1* – přívod; *2* – spoj kovu s keramikou; *3* – keramika; *4* – stěna vakuového systému

14

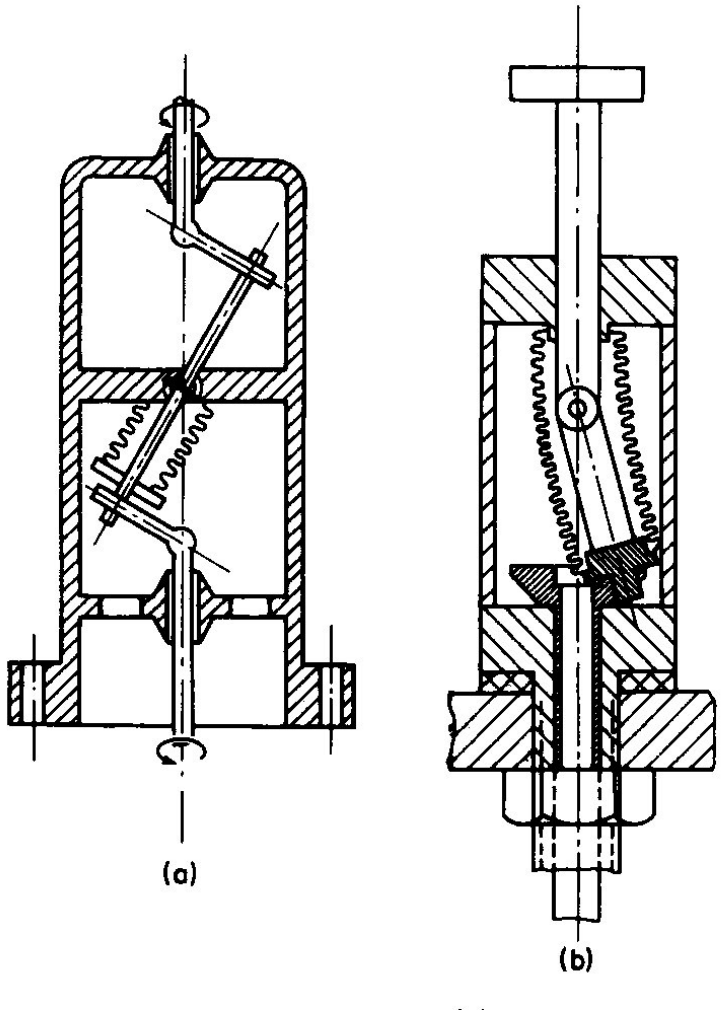
[14] J. Groszkowski: Technika vysokého vakua, SNTL, Praha 1981




15

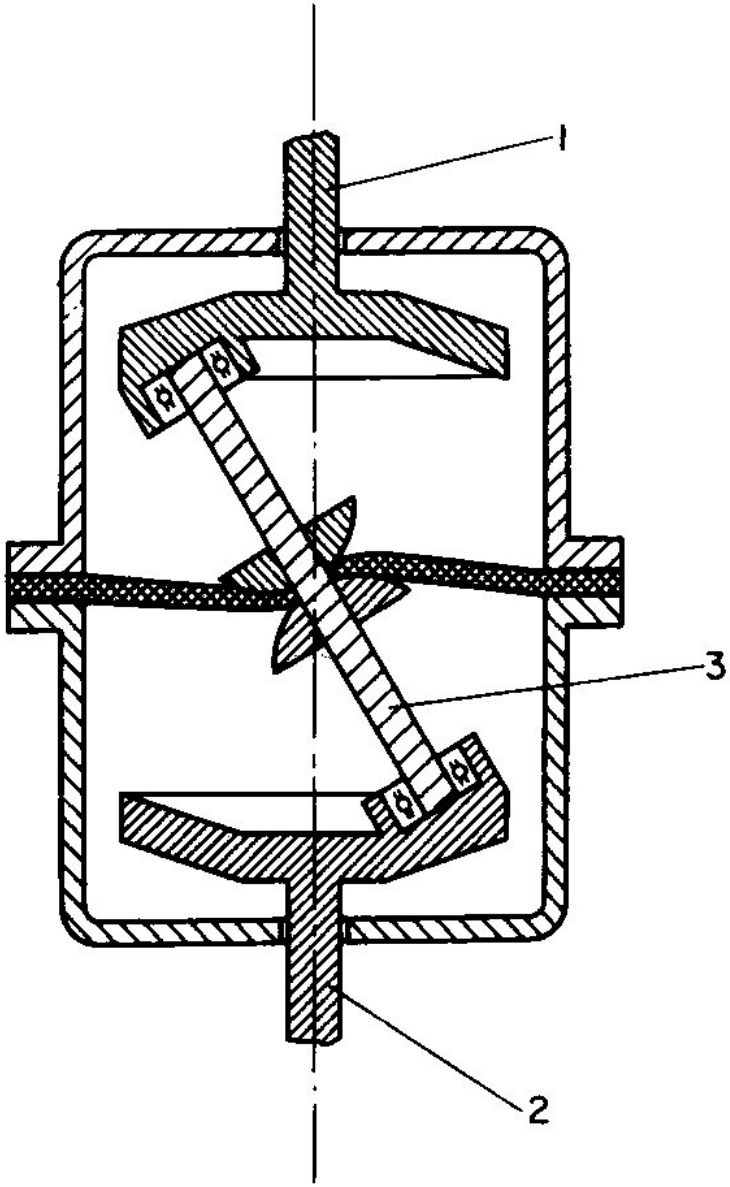
[15] A. Roth: Vacuum technology, Elsevier, 1990

# Přenos rotace do vakua



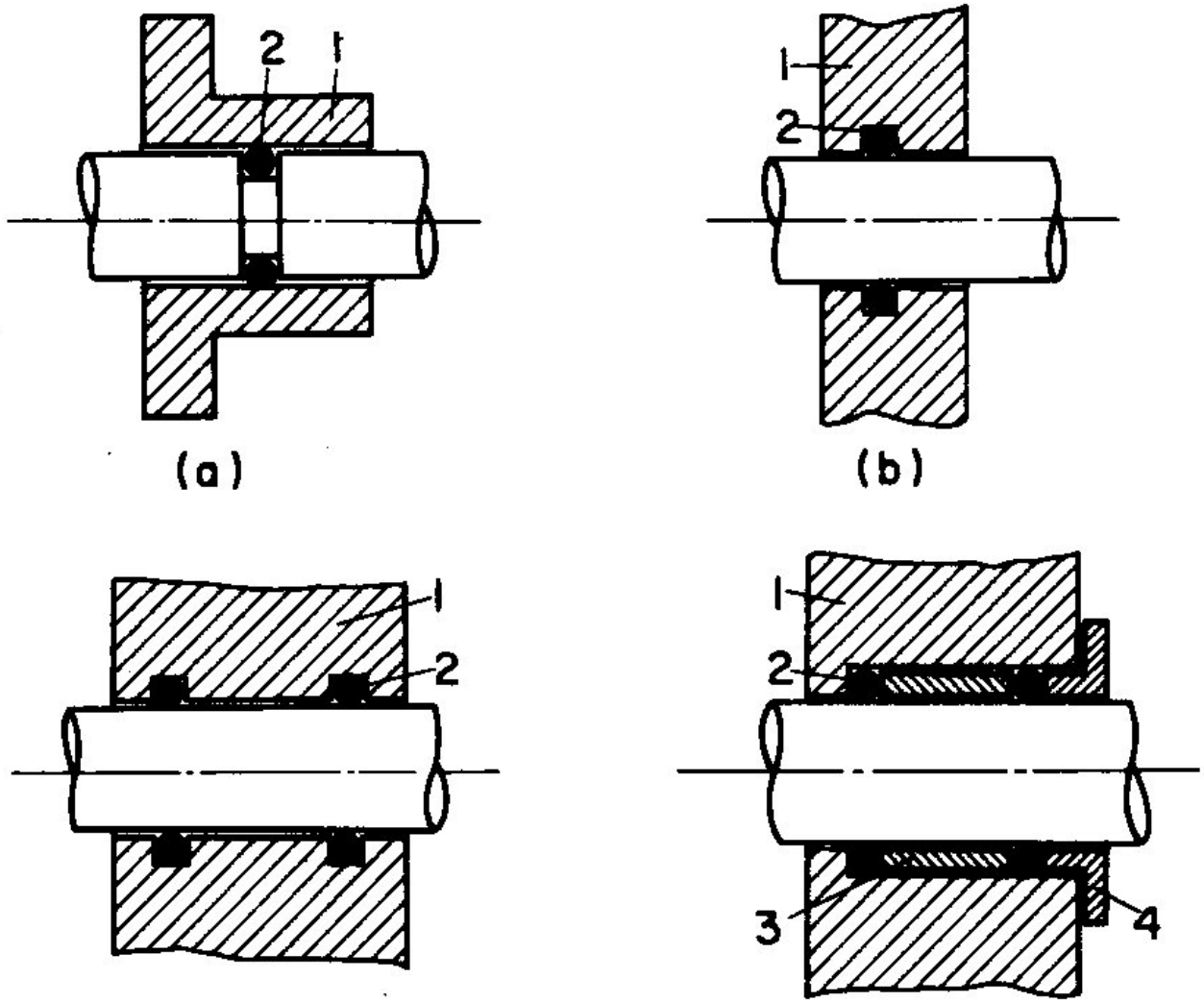

16

[16] A. Roth: Vacuum technology, Elsevier, 1990




17

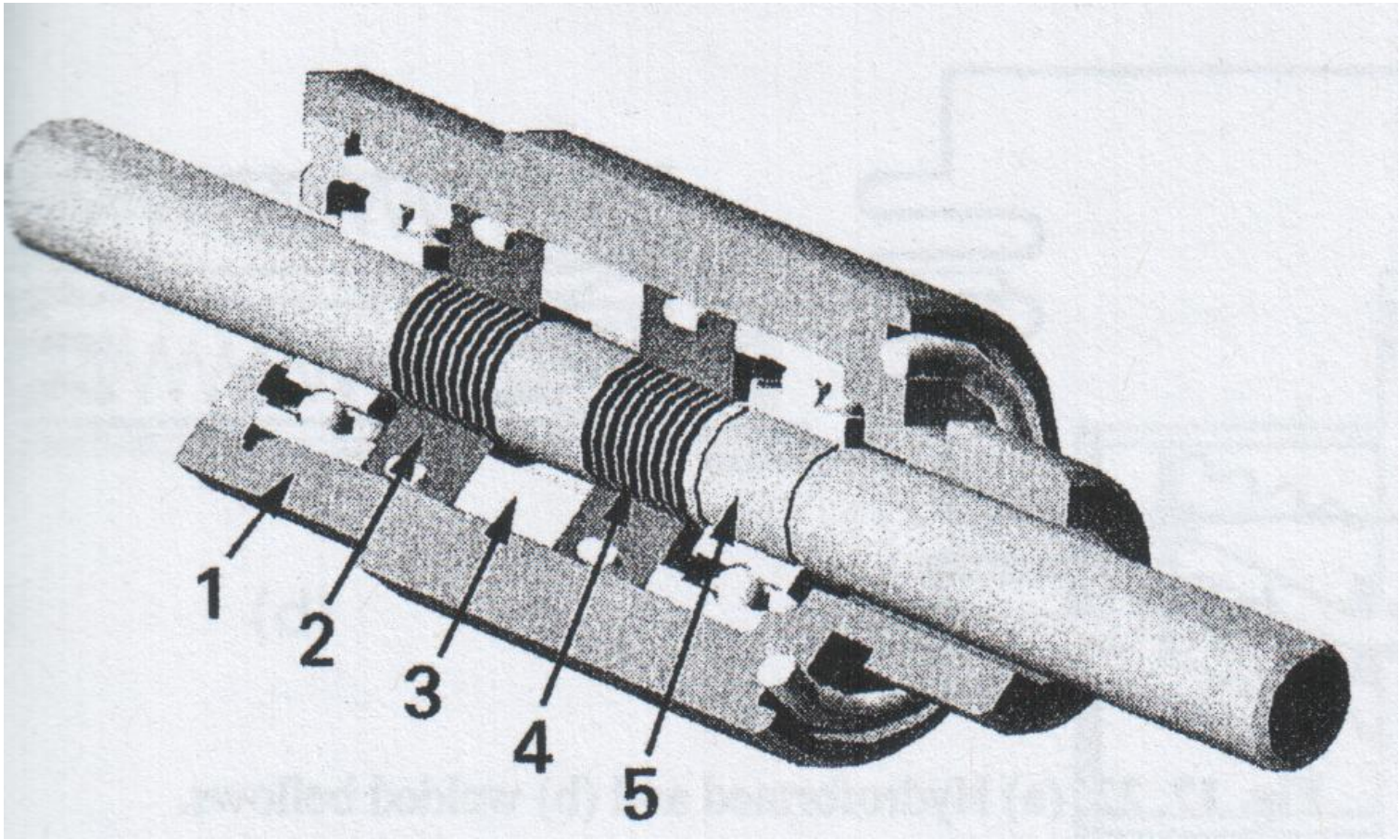
[17] A. Roth: Vacuum technology, Elsevier, 1990




18

[18] A. Roth: Vacuum technology, Elsevier, 1990

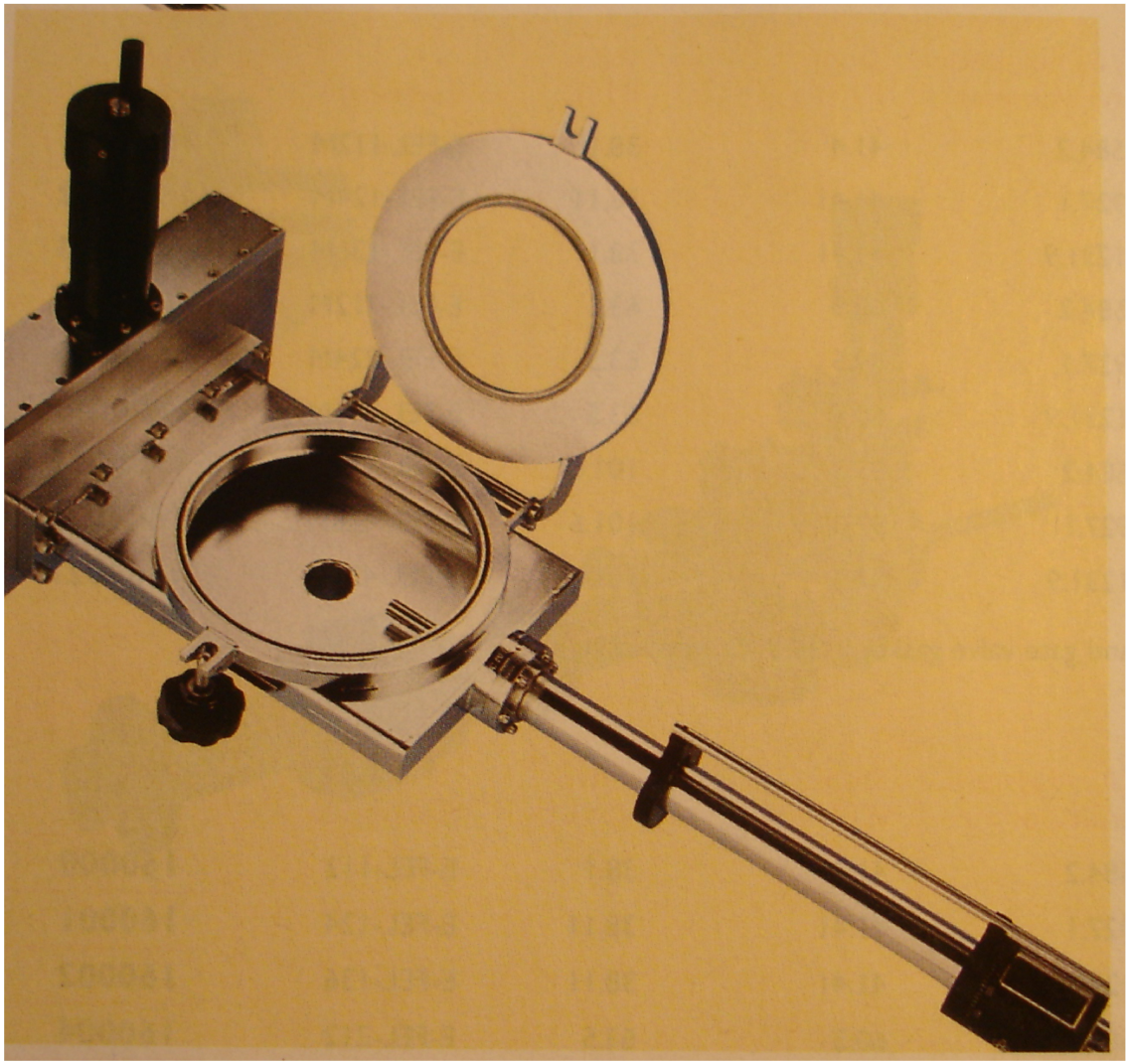
# Rotace - ferro kapaliny




19

[19] F.OHanlon: A Users Gaude to Vacuum Technology, Wiley (2003)

# Load lock



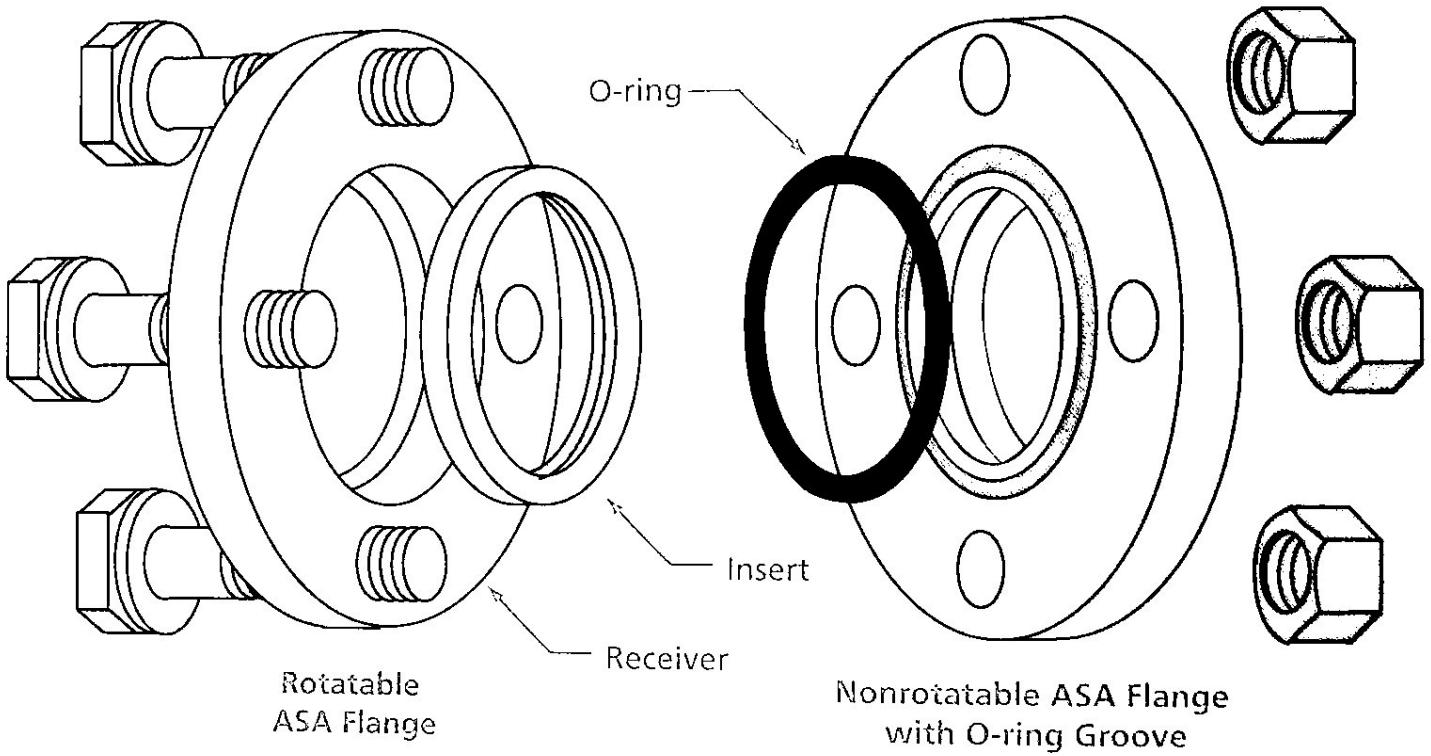
20

[20] firemní materiály firmy Caburn MDC

# Rozebiratelné spoje

- ASA
- ISO-KF, (NW)
- ISO-K, ISO-F
- CF
- Wire seal flanges
- Helicoflex

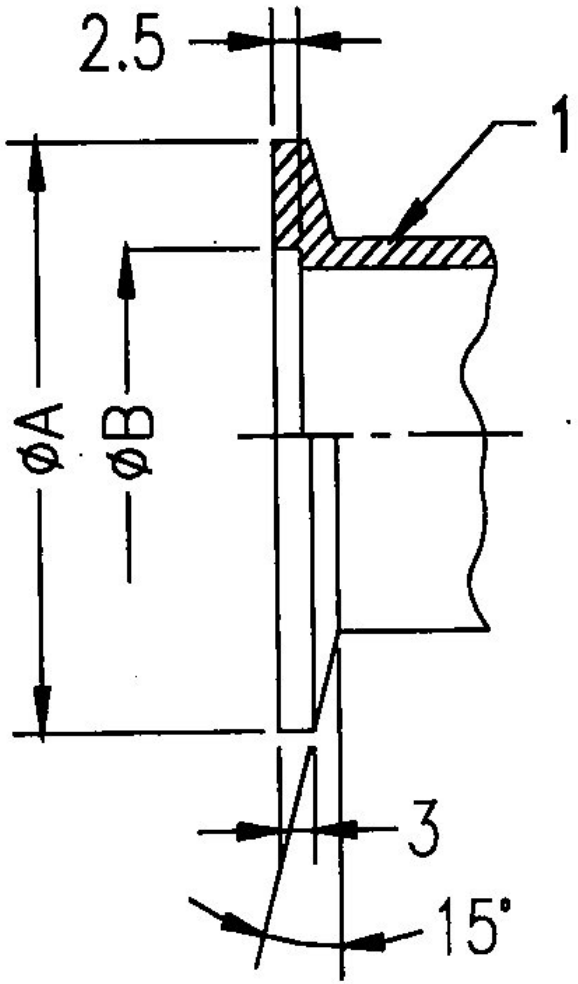
# ASA

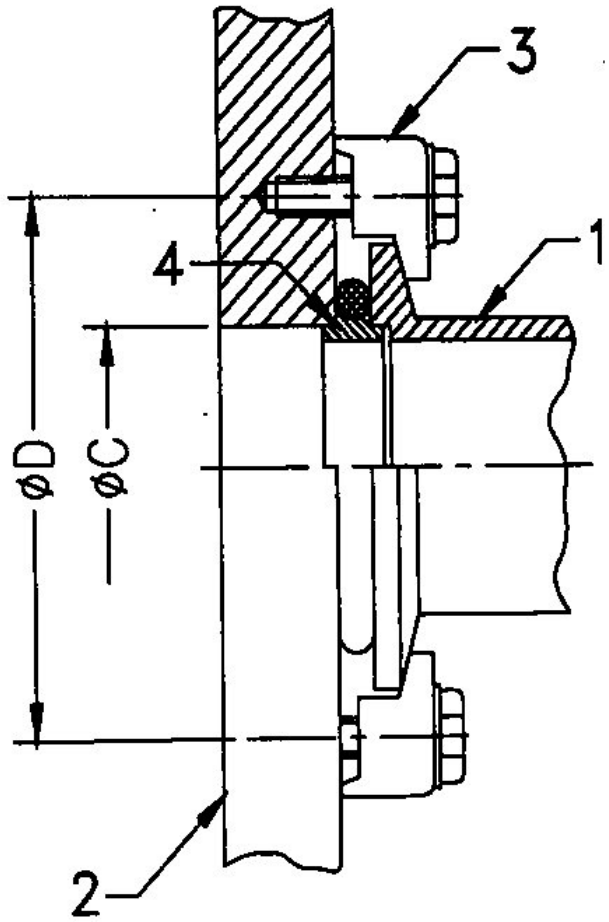



21

[21] firemní materiály firmy Nor-Cal

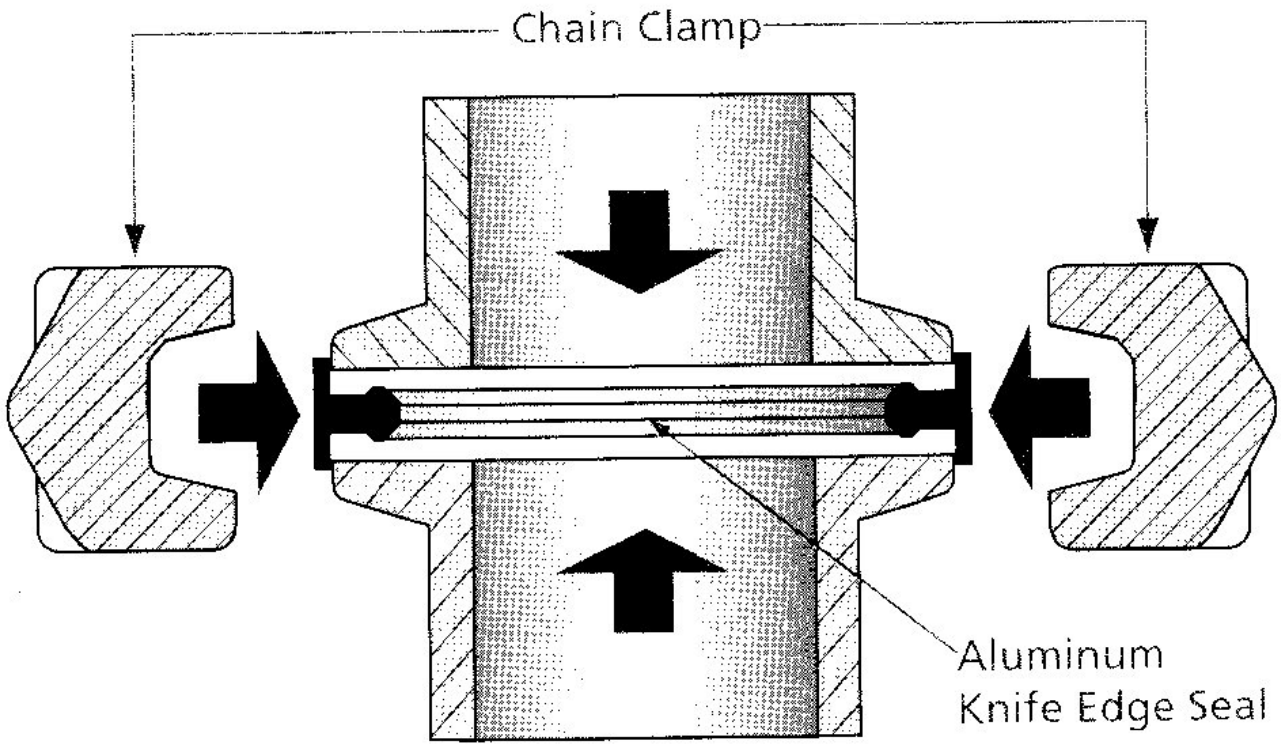
# ISO-KF




22

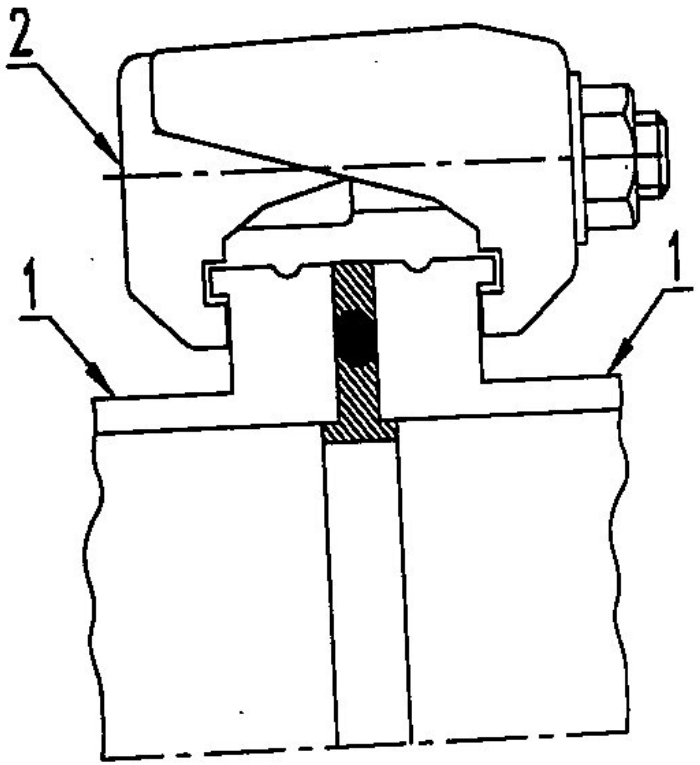
[22] firemní materiály firmy Pfeiffer

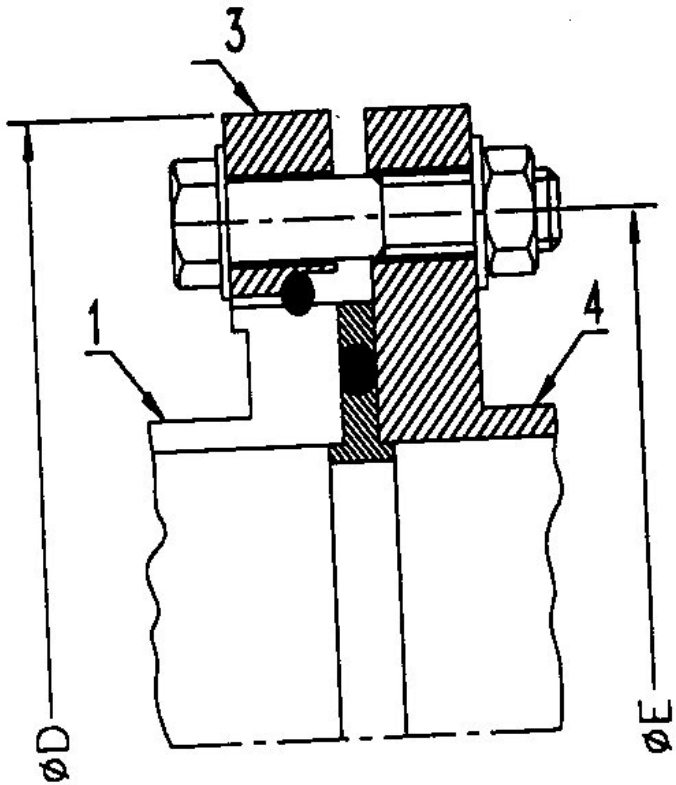



23

[23] firemní materiály firmy Nor-Cal

# ISO-K, ISO-F

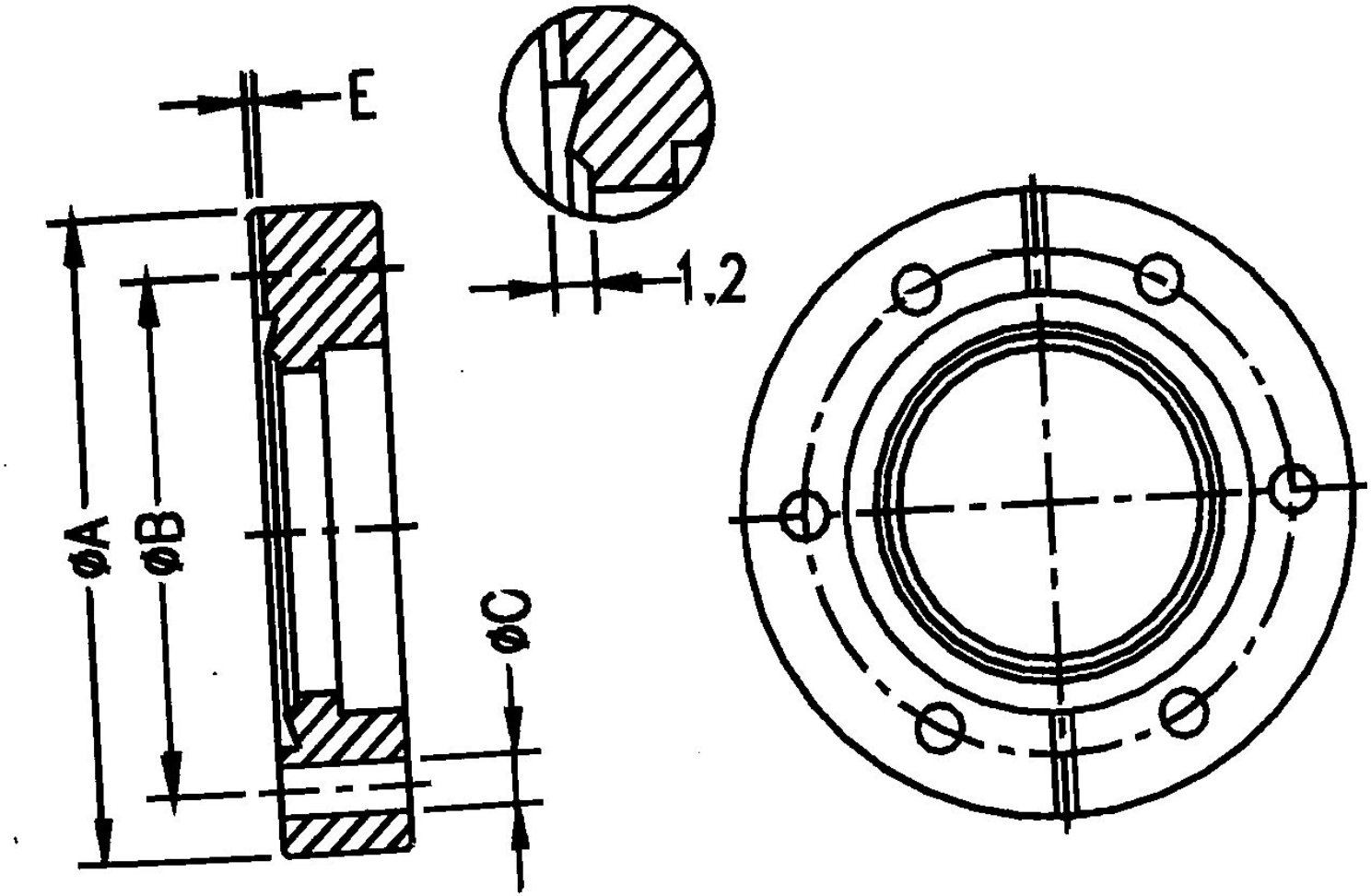



24

[24] firemní materiály firmy Pfeiffer

# CF




25

[25] firemní materiály firmy Pfeiffer

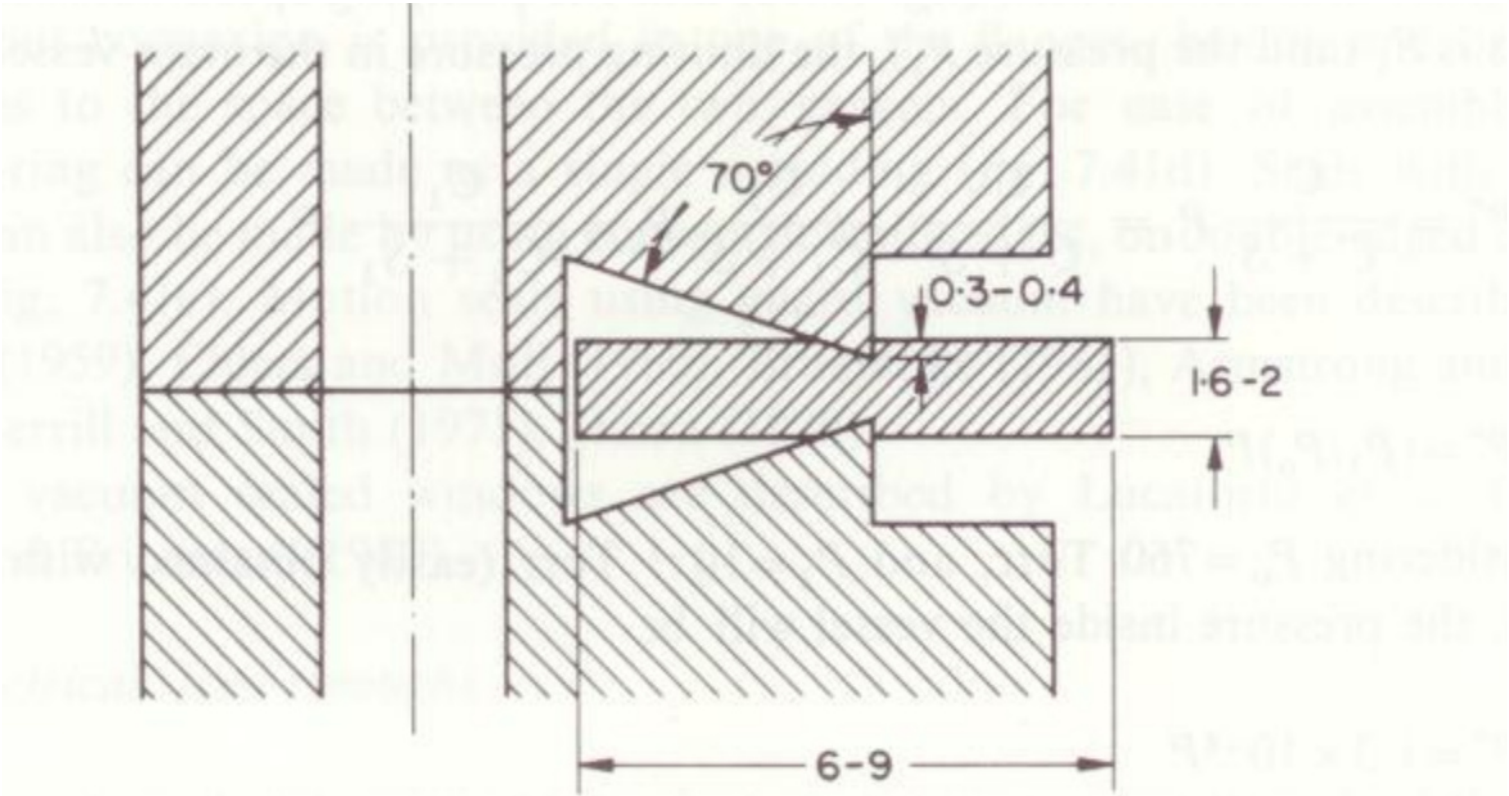
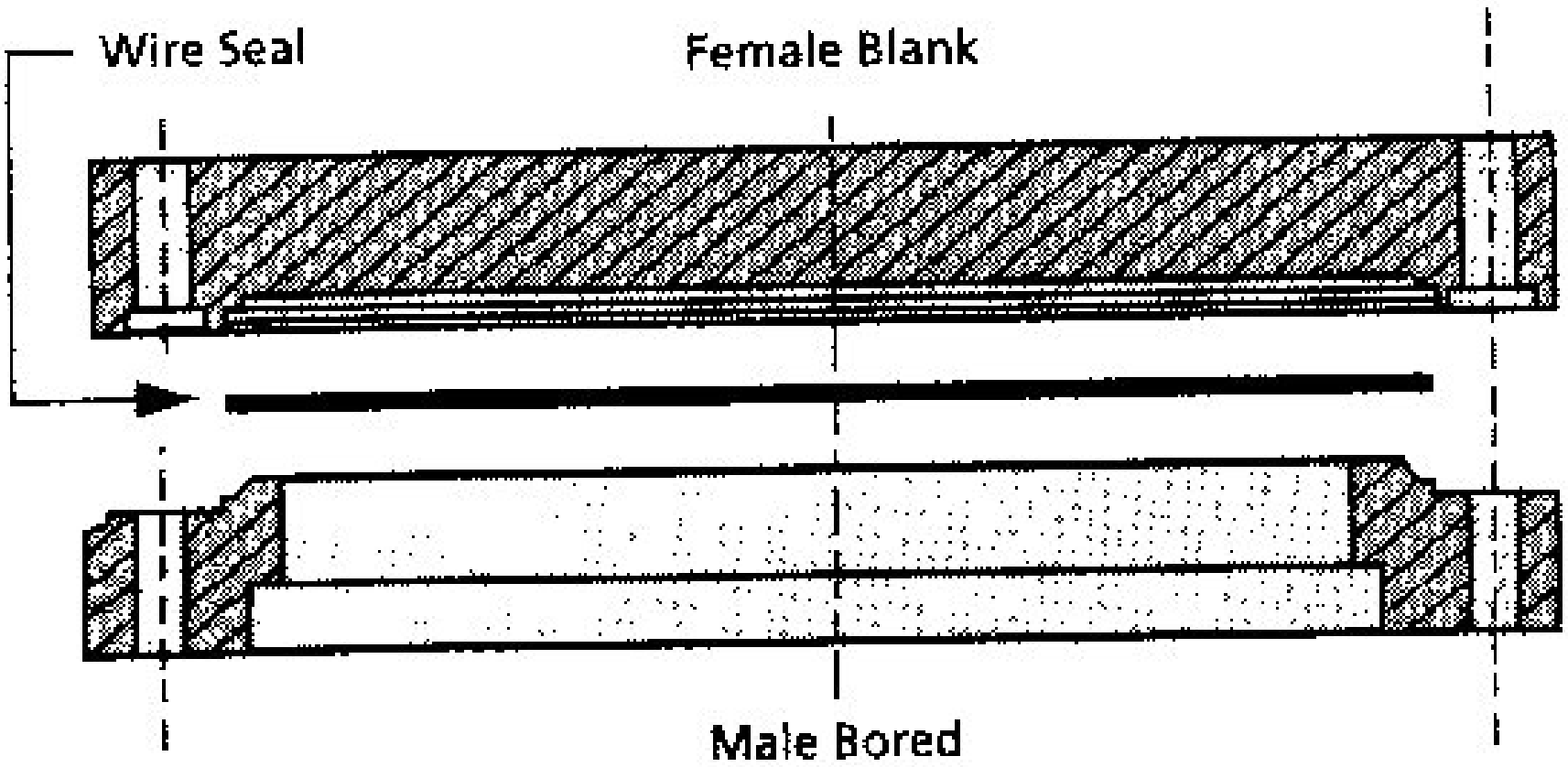



Fig. 7.39 The Conflat seal (Varian). After Wheeler and Carlson (1962).

26

[26] A. Roth: Vacuum technology, Elsevier, 1990

# Wire seal flanges




27

[27] firemní materiály firmy Nor-Cal

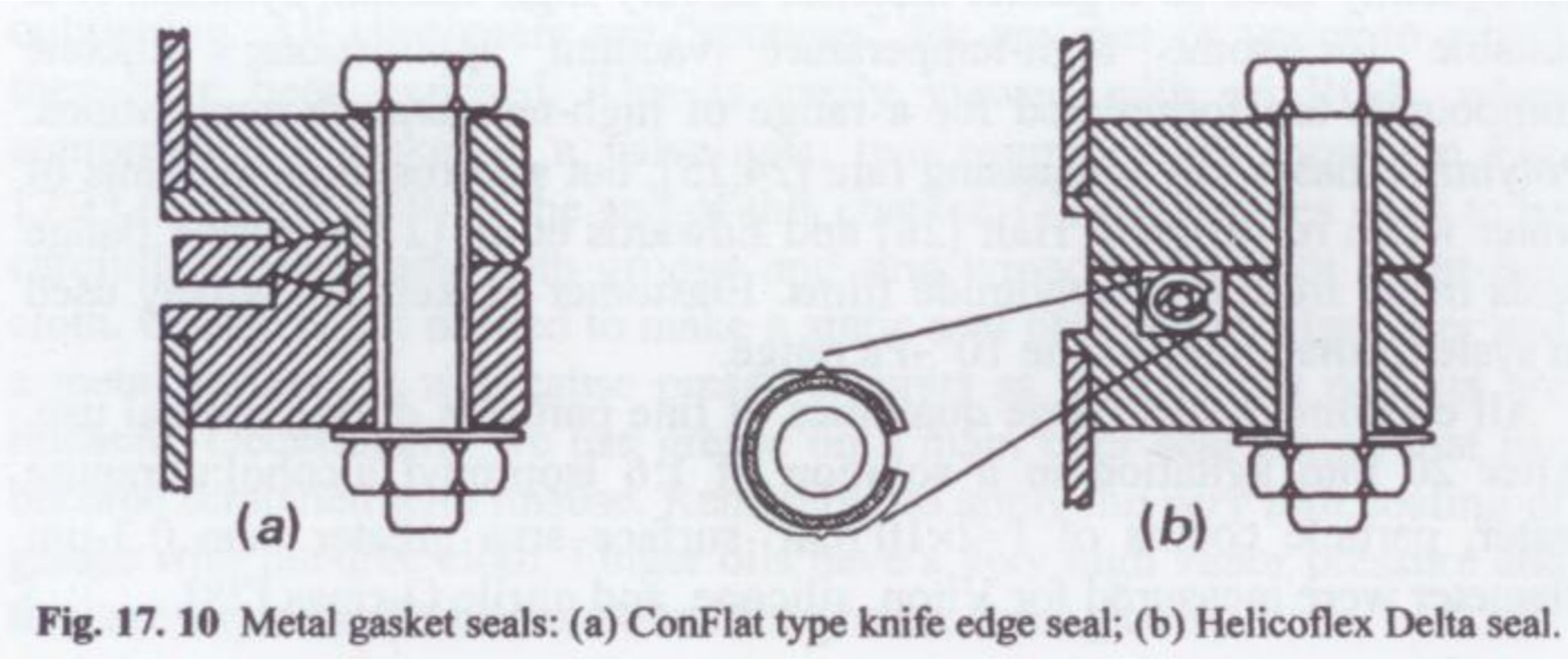



**Fig. 17. 10** Metal gasket seals: (a) ConFlat type knife edge seal; (b) Helicoflex Delta seal.

28

[28] F.OHanlon: A Users Gaude to Vacuum Technology, Wiley (2003)

| těsnění | min. tep [ $^{\circ}C$] | max. tep. [ $^{\circ}C$] |
|---|---|---|
| **elastomer** | | |
| FKM | -15 | 150 |
| NBR | -25 | 120 |
| CR | -5 | 120 |
| EPDM | -50 | 130 |
| silikon | -55 | 200 |
| **kov** | | |
| Cu | -196 | 200 |
| Cu + Ag | -196 | 450 |
| Al | -270 | 150 |
| In | -196 | 60 |

# Ohebné spoje

- připojení primárních vývěv
  - kovové vlnovce
    - bellows - změna délky při změně tlaku
    - flexible metal hose
  - tlustostěnné hadice
  - hadice s kovovou spirálou

# Další prvky

- tlakové spínače
- 2D a 3D posuvy
- ohřev a rotace vzorků
- systémy pro povlakování
- plazmové okénko

# Měrka pro XHV vakuum

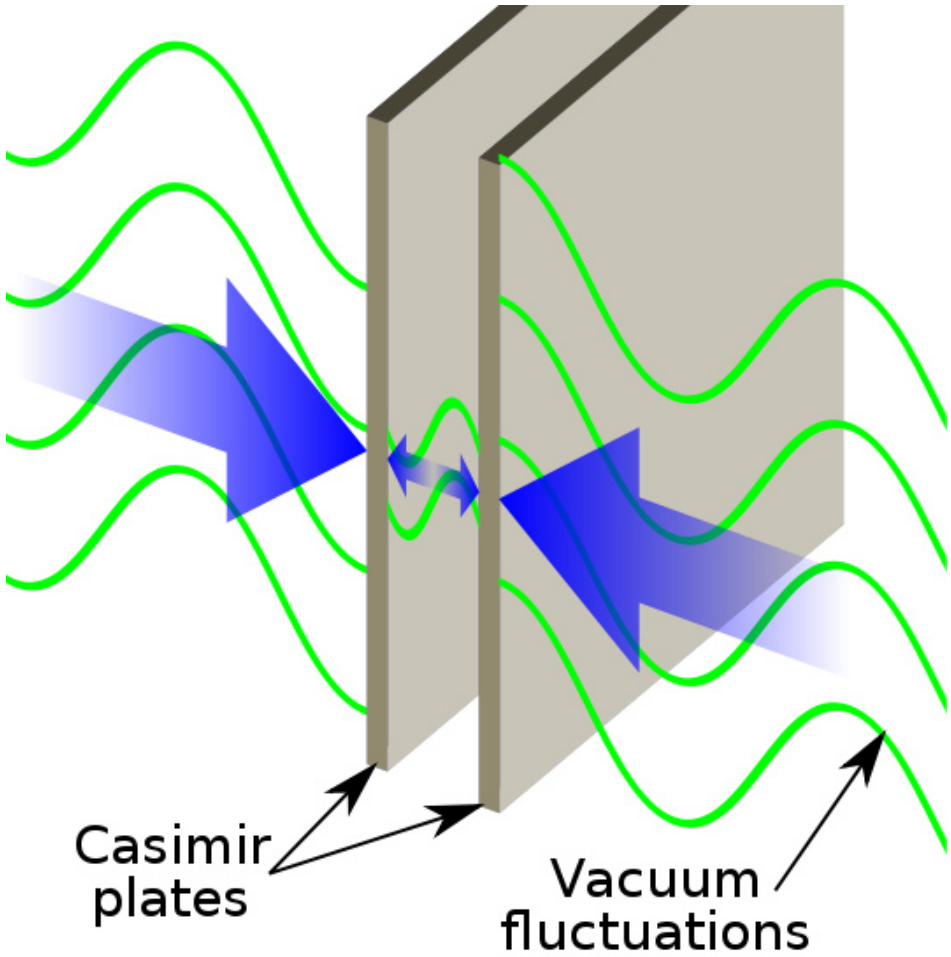
Bent Belt-Beam - ionizační manometr

- 3BG-03
- citlivost 5 $\sim 8 \times 10^{-2}\ Pa^{-1}$
- min. tlak $5 \times 10^{-12}\ Pa$

pro porovnaní ionizační manometr z vak. praktika PBR 260

- rozsah měření $5 \times 10^{-10} - 1000\ hPa$

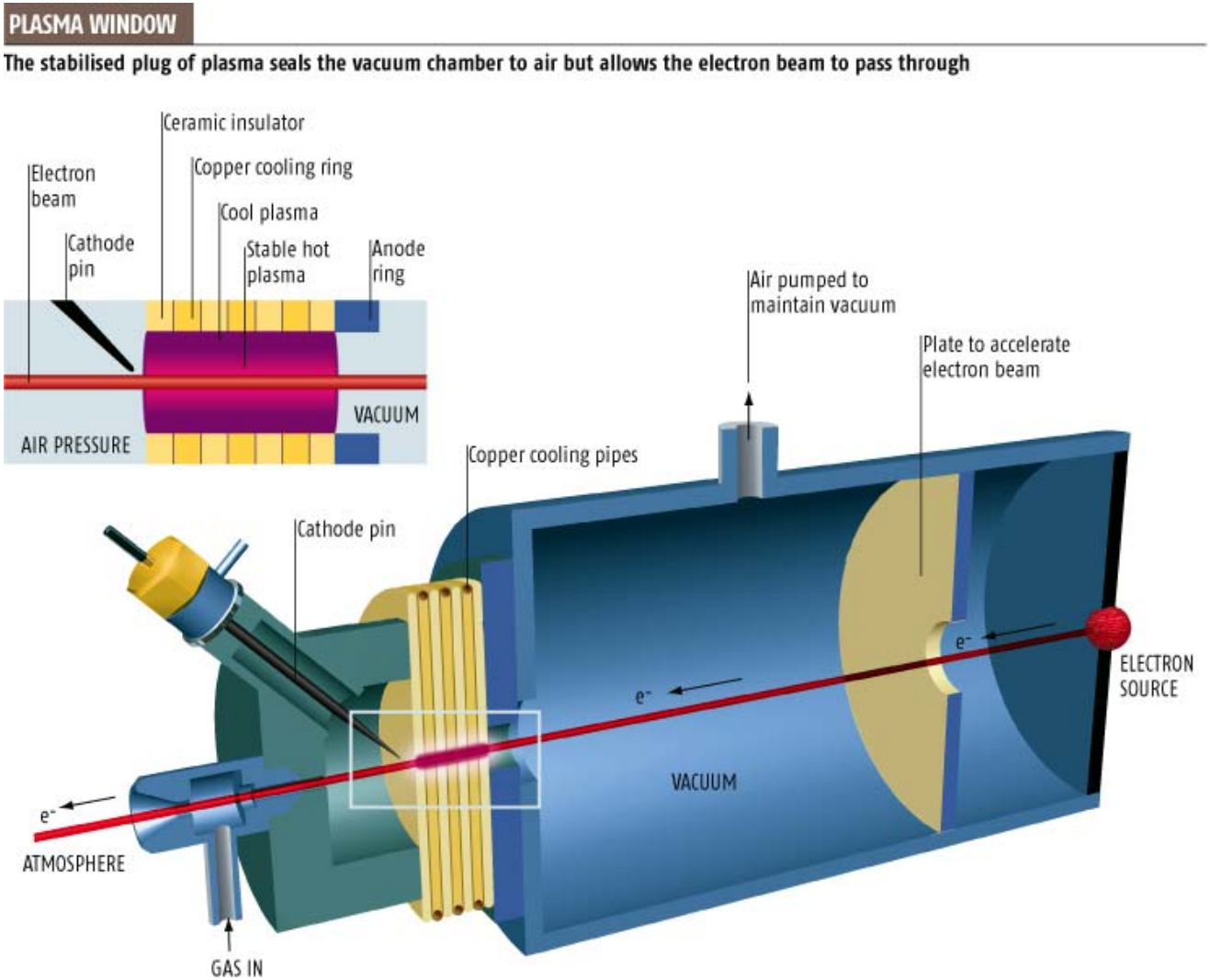
# Casimirův jev




29

[29] http://en.wikipedia.org/wiki/

# Plazmové okno




30

[30] http://www.newscientist.com

# Vodní pára ve vakuových systémech

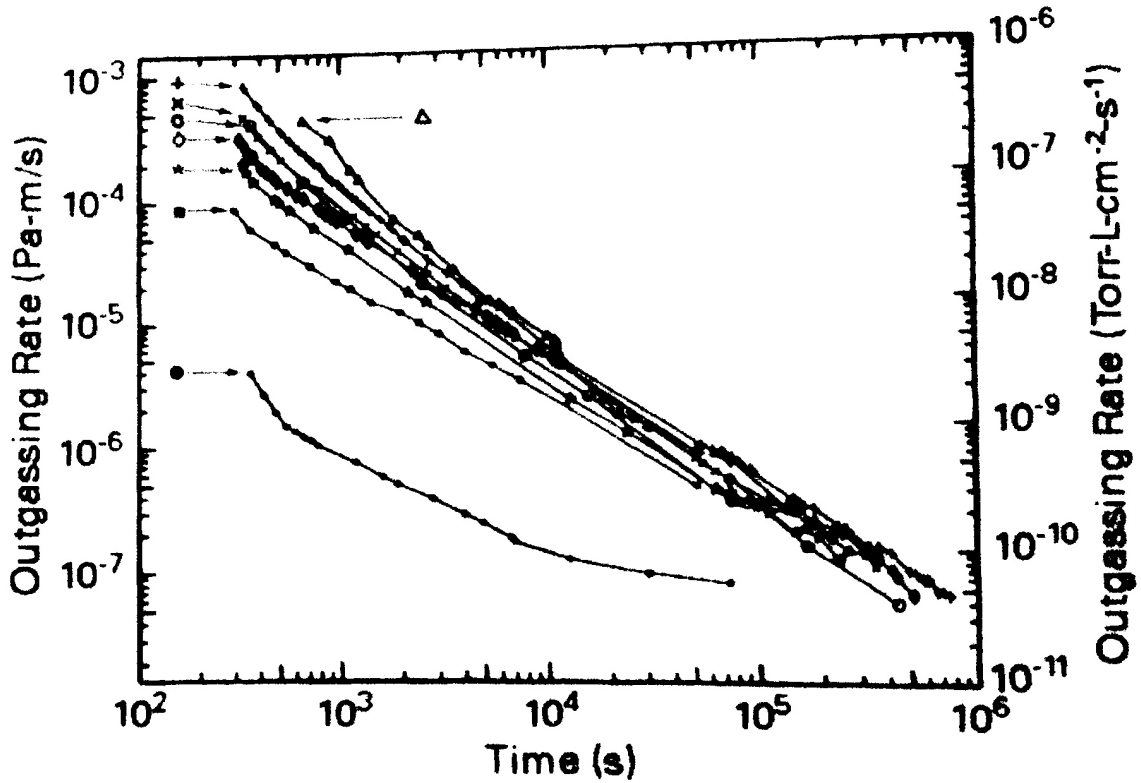



**Fig. 4.5** Outgassing measurements for different $H_2O$ exposures during venting of a 304 stainless steel chamber of inner surface area 0.4747 $m^2$. ○ Ambient air exposed, 7.8 ml absorbed; Δ 600 ml exposed, 16.8 ml absorbed; + 400 ml exposed, 9.2 ml absorbed; × 200 ml exposed, 7.2 ml absorbed; ◊ 100 ml exposed, 3.6 ml absorbed; ★ 10 ml exposed, 2.3 ml absorbed; ■ $N_2$ gas with <10 ppm $H_2O$ exposed, 0.7 ml absorbed; ● dry $N_2$ gas exposed, 0.017 ml absorbed; Reprinted with permission from *J. Vac. Sci. Technol. A*, 11, p. 1702, M. Li and H. F. Dylla. Copyright 1993, AVS–The Science and Technology Society.

31

[31] F.OHanlon: A Users Gaude to Vacuum Technology, Wiley (2003)

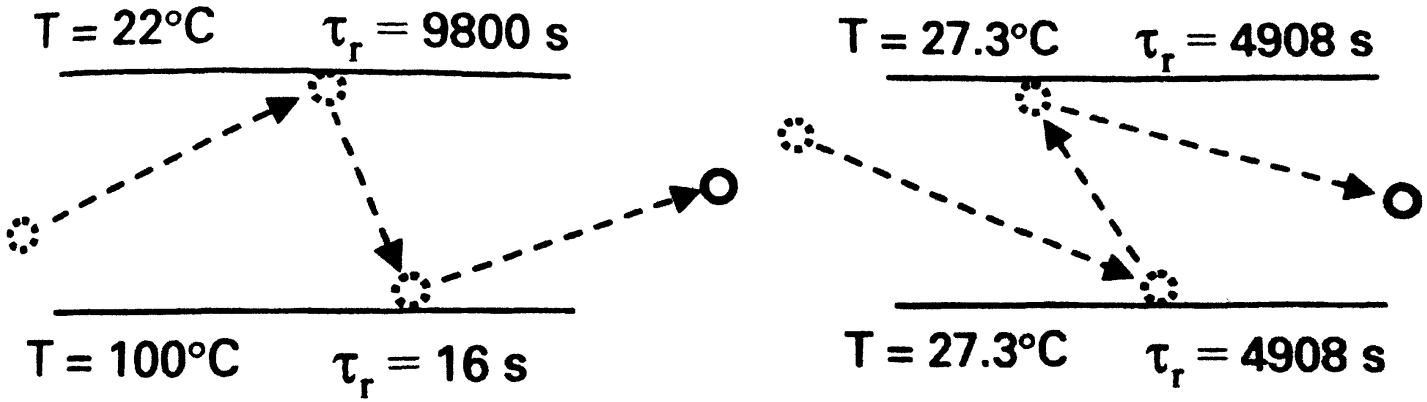
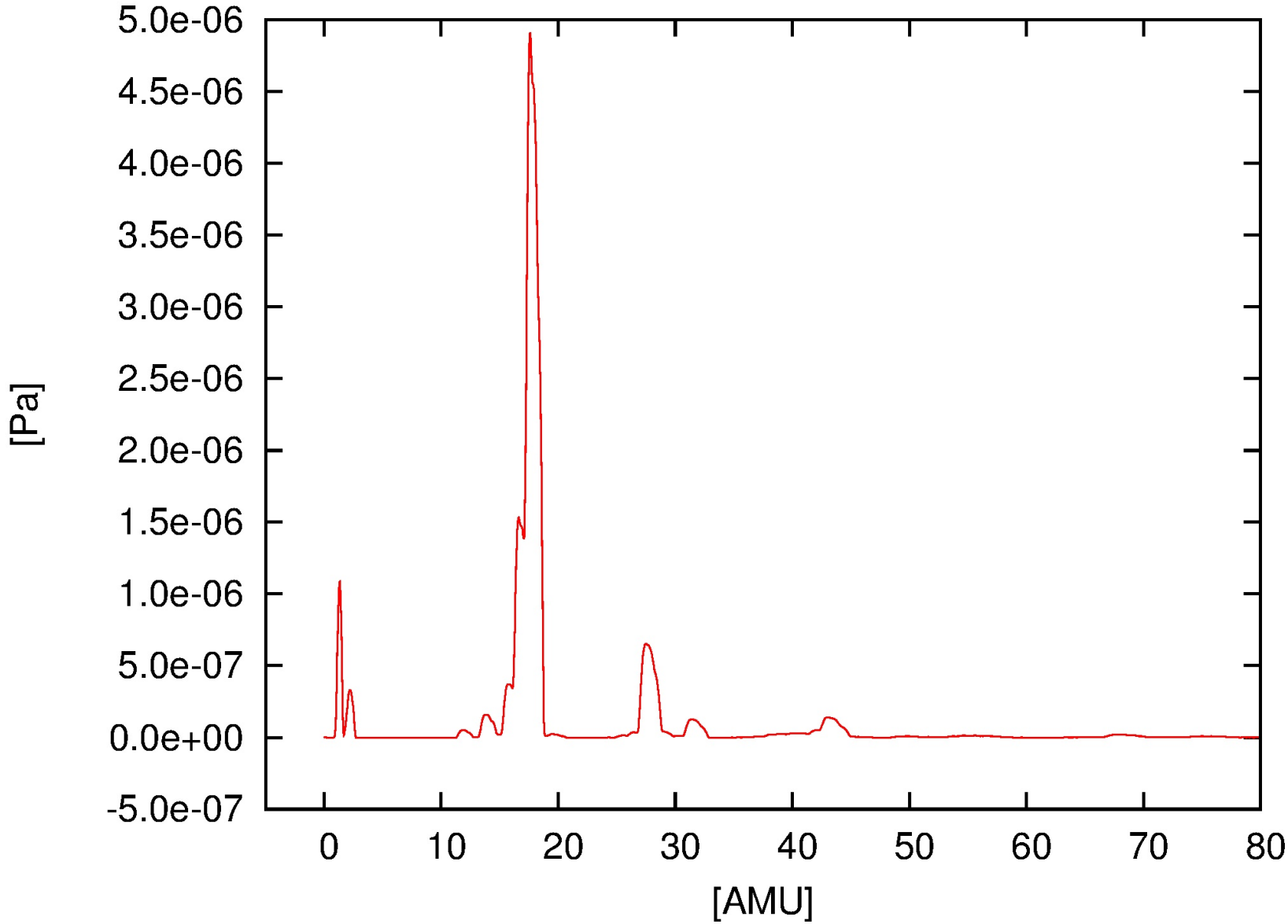


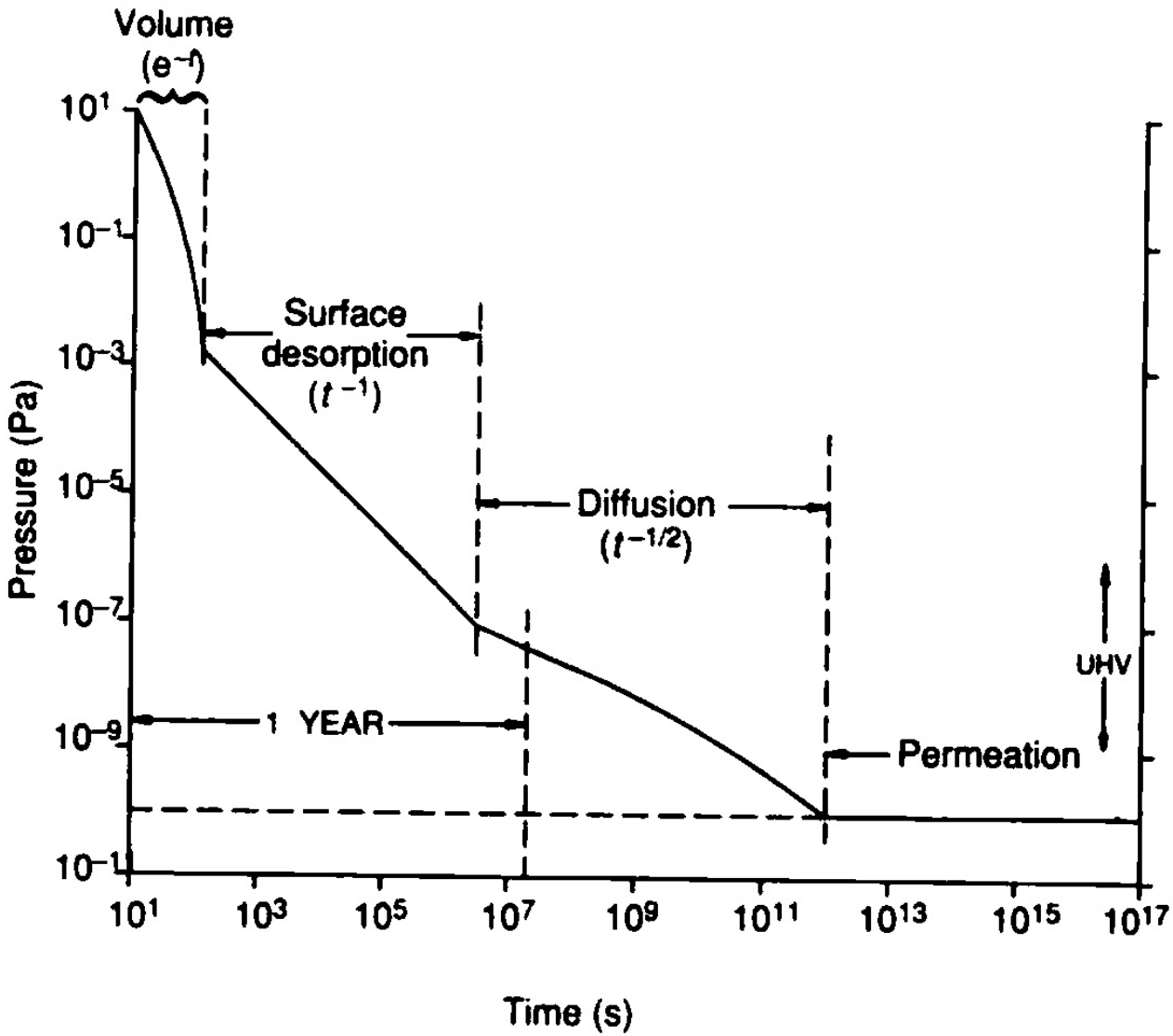

**Fig. 4.8** The total residence time for a water molecule after two bounces from a metal surface is shown to be the same for two sets of surface temperatures; a sticking coefficient of one was assumed. This example illustrates the necessity of baking all surfaces within a vacuum chamber. Unbaked surfaces dominate the behavior of the system.

32

[32] F.OHanlon: A Users Gaude to Vacuum Technology, Wiley (2003)


5.0e-06
4.5e-06
4.0e-06
3.5e-06
3.0e-06
2.5e-06
2.0e-06
1.5e-06
1.0e-06
5.0e-07
0.0e+00
-5.0e-07
[Pa]
0
10
20
30
40
50
60
70
80
[AMU]

# Typická křivka čerpání vakuové komory bez vypékání




Delchar: Vacuum Physics and Techniques, Chapman Hall, 1993

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- Letní školy vakuové techniky
- www.vakspol.cz