### 7.3.5. TA-Luft (German technical regulations for clean air)

These Technical Instructions serve to protect the general public and the neighborhood against harmful effects of air pollution on the environment and to provide precautions against harmful effects of air pollution in order to attain a high level of protection for the environment altogether.

#### 7.3.5.1 Immission Indicators, Assessment Points, Grid Points

Immission indicators describe the initial load, the additional load or the total load of the respective air pollutant. The initial load shall describe the pre-existing load of a pollutant. The additional load shall characterise the concentrations, which can be expected to be caused (for planned installations) or which are actually caused (for existing installations) by the planned project. With respect to planned installations, the indicator for the total load shall be calculated on the basis of the initial load plus the additional load indicators. With respect to existing installations, this indicator equals the initial load.

Assessment points shall be those points in the vicinity of an installation for which immission indicators, indicative of the total load, are determined. Grid points shall be those points in the vicinity of an installation for which the additional load is calculated (immission projection).

| Substance/Group of | Concentration | Averaging Period | Permissible Annual |
|---|---|---|---|
| Substances | µg/m³ | | Frequency of Exceeded Values |
| Benzene | 5 | 1 year | – |
| Lead and inorganic lead compounds, contained in suspended particulate matter (PM–10), to be indicated as Pb | 0.5 | 1 year | – |
| Suspended particulate matter (PM–10) | 40 | 1 year | – |
| | 50 | 24 hours | 35 |
| Sulphur dioxide | 50 | 1 year | – |
| | 125 | 24 hours | 3 |
| | 350 | 1 hour | 24 |
| Nitrogen dioxide | 40 | 1 year | - |
| | 200 | 1 hour | 18 |
| Tetrachloroethene | | 1 year | - |

*Table 7.3.5.1.-1: Substance Immission Values in order to Ensure the Protection of Human Health*

#### 7.3.5.2 Immission Values

The annual immission value shall be the concentration or deposition value of a substance averaged over one year.

The daily immission value shall be the concentration value of a substance averaged over one calendar day, taking into account the respective frequency limit for excess values (number of days) over one year.

The hourly immission value shall be the concentration value of a substance, averaged over a whole hour (e.g., from 8 a.m. to 9 a.m.), taking into account the respective frequency limit for excess values (number of hours) over one year.

### 7.3.5.3 Emissions

For the purposes of this Administrative Regulation, emissions shall be air pollutants originating from an installation.
Emissions shall be indicated as follows:

- Mass of substances or groups of substances emitted as related to the volume (mass concentration)
  - ◊ of waste gas under standard conditions (273.15 K and 101.3 kPa) after subtraction of the water vapor content,
  - ◊ of waste gas (wet) under standard conditions (273.15 K and 101.3 kPa)
- Before subtraction of the water vapor content,
- Mass of substances or groups of substances emitted per unit time as a mass flow (emitted mass flow); the mass flow is the total emission occurring in one hour of normal operation of an installation under operating conditions which are most unfavorable to the maintenance of air quality;
- Quantity of fibres emitted (fibre dust concentration), as related to the volume of waste gas under standard conditions (273.15 K and 101.3 kPa) after subtraction of the water vapor content;
- Ratio of the mass of emitted substances or groups of substances to the mass of products generated or processed or to stocking density (emission factor); the mass ratio shall take into account the total emissions from the installation occurring over one day of normal operation of such installation under operating conditions most unfavorable to the maintenance of air quality;
- Amount of Odor Units of odorous substances emitted, as related to the volume (odorous substances concentration) of waste gas at 293.15 K and 101.3 kPa before subtraction of the water vapor content; the odorous substances concentration is the olfactometrically-measured ratio of volume flows when diluting a waste gas sample with neutral air down to the odor threshold, indicated as a multiple to the odor threshold.

### 7.3.5.4 Emission Ratio and Emission Reduction Ratio

The emission ratio shall be the ratio of the mass of an air pollutant emitted in waste gas to the mass of supplied fuels or input materials; it shall be provided as a percentage.
The emission reduction ratio shall be the ratio of the mass of an air pollutant emitted In waste gas to its mass supplied in crude gas; it shall be provided as a percentage.
The odor reduction ratio is an emission reduction ratio.

### 7.3.5.5 Further reduction of fugitive emissions as the main aim

- Environmental protection
  - Hence a further reduction of detrimental effects on the environment and healthiness caused by pollutants
  - VOC' s are called ozone precursors (formation of ground-level ozone)
    - ◊ Greenhouse effect (global warming)
    - ◊ Kyoto Protocol
    - ◊ Adverse health effects
  - Employment protection
  - Industrial safety and health protection
- Economic efficiency
  - Leakage as cost factor (loss by leakage), for example:
    - ◊ Hence leakage reduction => Reduction cost of ownership
    - ◊ Leakage reduction => Reduction of maintenance
    - ◊ Leakage reduction => Reduction of plant shutdown

### 7.3.5.6 International / national / company standards

Different standards for leak detection:

- International standard: ISO 15848
- National standards:
  - ◊ VDI 2440 / TA-Luft
  - ◊ ANSI/FCI 91-1-1997 (R2003)
  - ◊ API 622
- Company standards (e.g.): MESC SPE 77/312

**Different methods for detection (in the field or for equivalence analysis)**

- Vacuum method, flushing method or sniffing method

**Other participants (e.g.):**

- EU IPPC
- ESA
- VDMA
- EPA (LDAR Program)

### 7.3.5.7 VDI 2440

Among other things, they pursue the objective of reducing emissions with gasket systems as normally used in the chemicals and petrochemical industries. TA-Luft only gives guidelines in respect of compliance with permissible leakage limits and refers to

regulations which define basic conditions for inspections. For shutoff and regulating valves, this affects VDI (Association of German Engineers) Guideline 2440, which may be regarded as state-of-the-art from a legal perspective.

Guideline VDI 2440 refers to average gas-like emissions for differing gasket systems but these are not upper limits (see Table 1).

| Average gaseous emissions (leakage) and valve gaskets | |
|---|---|
| Gasket system | Leakage related to the average size of the gasket mg/(s · m) |
| Stuffing box with packing | 1.0 |
| Stuffing box with cup leather, O-ring | 0.1 |
| Stuffing box with packing, stuffing box with cup leather, O-Ring (with "TA Air Certificate" according to VDI 2440, Section 3.3.1.3) | 0.01 |
| Metallic bellows, sealed | 0.01 |
| Metallic bellows, sealed (with flat gasket possessing a TA-Luft Certificate according to VDI 2440) | 0.001 |
| Stuffing box with packing and sealing medium/ suction, metallic bellows, welded on both sides | No emission (Technically leak-proof) |

*Table 7.3.5.7.-1: Average gaseous emissions (leakage) and valve gaskets*

VDI 2440 refers to the use of high quality metallic bellows with a downstream safety stuffing box or equivalent gasket systems as a particularly effective means of reducing emissions. In other words, metallic bellows and so-called “equivalent gasket systems” are established as conforming to TA-Luft. This means that only these kinds of gasket systems may be used in Germany on shutoff and regulating valves when a TA-Luft medium is subsidized.
Gasket systems may be regarded as equivalent if they fulfil the following conditions:

- The construction of the gasket system can be expected to permit its regulation function under operating conditions.
- Compliance with specific leakage rate with reference to the average size of the gasket, from $10^{-4}$ mbar · l/(s · m) at temperatures of less than 250 °C and from $10^{-2}$ mbar · l/(s · m) at temperatures on the gasket system of greater than 250 °C is proven at the first inspection.

**No specific explanation is given on construction under**

- As to why this guideline is difficult to understand. On the other hand, the determination of a leakage rate to be complied with under
- For all gaskets except metallic bellows is crucial in order to get valves that fulfil the conditions of this certificate onto the market.

Guideline VDI 2440 describes a testing procedure with which the above-mentioned certificate can be shown.

**The ancillary conditions here are:**

1. Testing medium: helium;
2. Testing pressure: nominal pressure;
3. Testing temperature: permissible operating temperature;
4. Before the test, a representative number of switching cycles is carried out depending on the operating conditions (switching rate);
5. Test: with static and moving spindle/shaft;
6. Leak rate: leakage resulting after at least 24-hour admission flow with helium under the given testing conditions.

If the leak in (6.) is less than $10^{-4}$ mbar · l/(s · m) (up to 250 °C) or $10^{-2}$ mbar · l/(s · m) (over/the same as 250 °C), the valve may be regarded as TA-Luft compliant and may be used with TA-Luft media.

**For example: Critical service**

**Service:** Quench oil / Coke particles (153 °C)

**Solution:** VETEC Type 72.2 M, DN 300 / NPS 12, PN 300, $K_{VS}$ 670
Class IV
Body A216 WCC + liner hardened metal
Plug/seat Stellite 6 / hardened metal
(Ceramic instead of hardened metal applicable)
TA-Luft / Viton O-rings
FTO

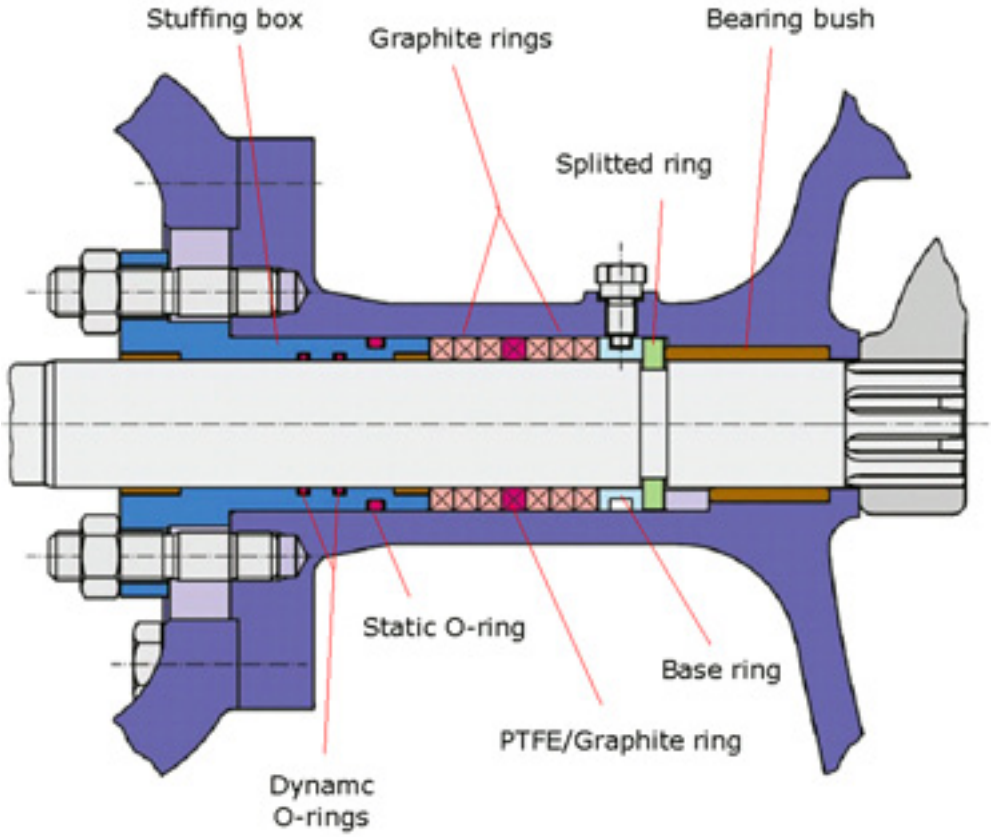



*Figure 7.3.5.7.-2: VETEC TA-Luft design in 72.X and 82.X series equivalent bellows seal*

### 7.3.5.8 DIN EN ISO 15848-1:2006[1]

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

ISO norm EN ISO 15848-1 has been valid since 2006. It refers exclusively to valves and describes, independent of the guidelines of TA-Luft and VDI 2440 respectively, detailed tests for determining leakage and the creep behavior of valves. The norm was developed under the overall control of the CEN/TC 69 “Industrial Valves” Committee.

**The norm distinguishes between the following parameters:**

- 3 grades of imperviousness for the spindle/shaft;
- 1 grade of imperviousness for the body gasket;
- 2 testing media (helium and methane);
- 3 grades of firmness;
- 5 grades of temperature; and 1 distinction between shutoff and regulating valves.

Table 7.3.5.8.-1 shows the following grades of imperviousness for die spindle and the shaft.

| Tightness classes for stem (or shaft) seals | | |
|---|---|---|
| Grade | Measured leakage rate $mg \cdot s^{-1} \cdot m^{-1}$ | Remarks |
| A* | $\leq 10^{-6}$ | Typically achieved with bellow seals or equivalent stem (shaft) sealing system for quarter turn valves |
| B | $\leq 10^{-4}$ | Typically achieved with PTFE based packings or elastomeric seals |
| C | $\leq 10^{-2}$ | Typically achieved with flexible graphite based packings |
| * Class A can be measured only with helium using the vacuum method. | | |

*Table 7.3.5.8.-1: Tightness classes for stem (or shaft) seals*

| Leakage from body seals |
|---|
| Measured concentration ppmv |
| ≤ 50 |
| NOTE Expressed in ppmv measured with the sniffing method as defined in Annex B (1 ppmv = 1 $ml/m^3$ = 1 $cm^3/m^3$). |

*Figure 7.3.5.8.-2: Leakage from body seals*

1 www.valve-world.net, Professor Dr.-Ing. Alexander Riedl, University of Applied Sciences Muenster, Germany

### Helium as test fluid

When the test fluid is helium, the tightness classes are identified as Class AH, Class BH and Class CH.

### Methane as test fluid

When the test fluid is methane, the tightness classes are identified as Class BM and Class CM.

The required imperviousness for the body gasket, measured using the sniffing method, may not exceed 50 ppmv (1 ppmv = 1 $cm^3/m^3$). In respect of the media, the norm is not intended to achieve any comparability, but less leakage may be expected than with helium. However, this statement requires testing. The leakage tests are conducted both at room temperature and at maximum operating temperature, taking cycles of differing lengths. The gasket connection may only be re-tightened to a limited extent.

**Note:** The concentration is expressed in ppmv (**p**arts **p**er **m**illion **v**olume), which is a unit deprecated by ISO (1 ppmv = 1 $ml/m^3$ = 1 $cm^3/m^3$).

At the moment the author does not know whether any European country or the EU has adopted the norm in order to convert the limits described here into national or European law. Through the precise guidelines, however, it is expected that this will be carried out within the foreseeable future. The same applies to the stability and temperature grades described below.

The shutoff and regulating valves differ by stability grades, but the classification to a grade of stability is given by the number of cycles in which a certain grade of imperviousness (see Table 7.3.5.7.-1) has not been exceeded. With the shutoff valves the norm assumes a maximum cycle of 2,500 and with the regulating valves, a maximum cycle of 105 cycles. Differences are described in three grades of firmness shown in Table 7.3.5.8.-3 below.

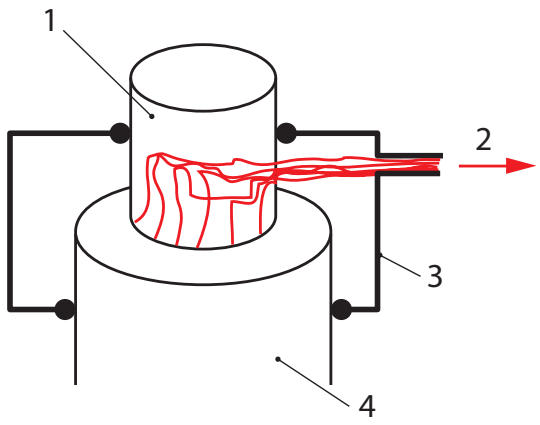
| Stability grade for shutoff and regulating valves | | | |
|---|---|---|---|
| Type | Stability grade | Cycle | Temperature cycles |
| Regulating valve | CO1 | 500 | 2 |
| | CO2 | 1,500 | 3 |
| | CO3 | 2,500 | 4 |
| Regulating valve | CC1 | 20,000 | 2 |
| | CC2 | 60,000 | 3 |
| | CC3 | 100,000 | 4 |

*Table 7.3.5.8.-3: Stability grade for shutoff and regulating valves*

The testing temperatures are subdivided into five grades and an area of -29 °C to +40 °C is given for room temperature (see Table 7.3.5.10.-3).

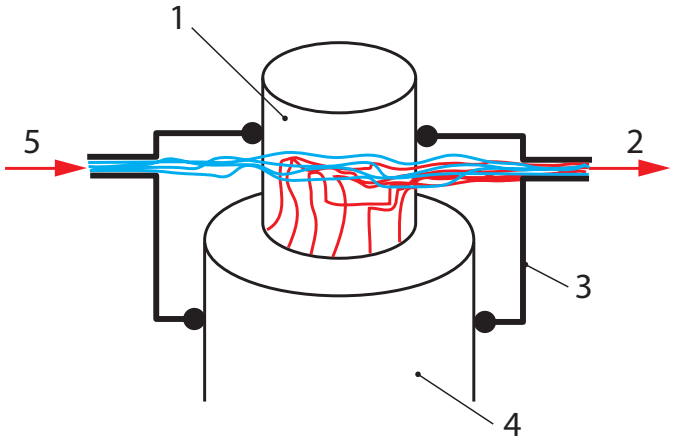
## Test methods overview

### Vacuum method



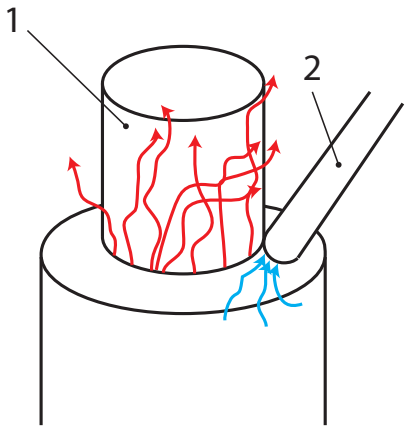

**Legend**
1 Valve stem
2 to detector
3 flush chamber
4 valve body

### Flushing method




**Legend**
1 Valve stem
2 to detector
3 flush chamber
4 valve body
5 flush gas

### Sniffing method




**Legend**
1 Valve stem
2 probe

*Figure 7.3.5.8.-4: Test methods overview*

### 7.3.5.9 Additional requirements concerning the sealing system for control valves

Situation today (to meet the requirements of control valve manufacturers)

- Applicable for all kinds of fluids [chemical resistance of packing material (pH 0 to 14)]
- Must be acc. to the different FE-regulations (international / national / company standards)
- A low friction sealing system / equal stick-slip free
- Demand on high quality of control
- Maintenance free packing set (live-loaded)
- Free from wear packing materials (valve pressure rating up to PN 400 / Class 2500)
- Applicable for sliding stem valves and for rotary valves
- Fail safe design
- Additional certificates, e.g.
  - ◊ $O_2$ – certificate
  - ◊ FDA – certificate
  - ◊ Fire Safe – certificate
- Limitation for the use of lubricants
- Life-cycle-cost / total cost of ownership

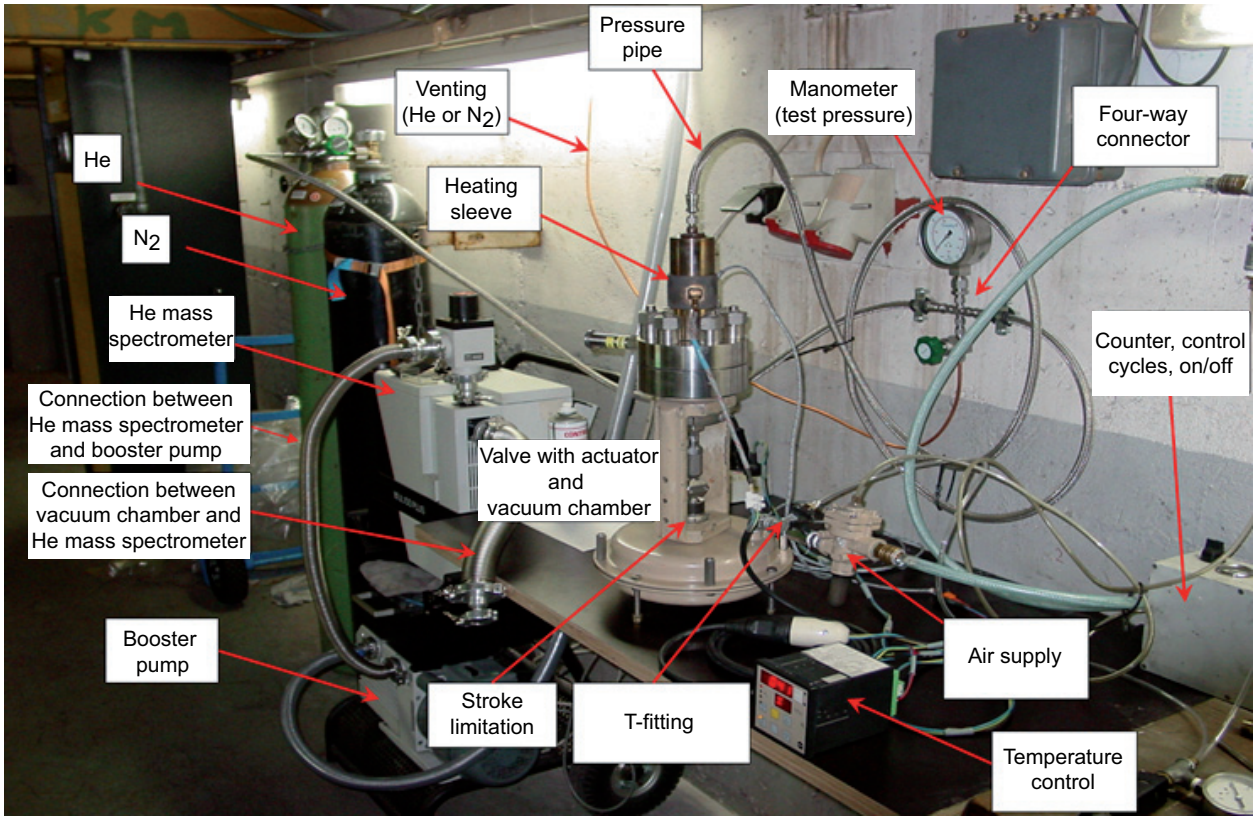



*Figure 7.3.5.9.-1: Test set-up (up to 160 bar, up to 220 °C)*