Reduction of fugitive emissions: the new TA Luft

Climate protection and the limitation of diffuse volatile organic compound (VOC) emissions are among the current challenges in all industrial sectors. Corresponding regulations or guidelines exist worldwide in which these topics are addressed. This year, an important guideline - TA Luft - will be published in a new version.

By Dr.-Ing. Manfred Schaaf

In Europe, the Industrial Emission Directive (IED) can be mentioned here first. Detailed requirements for the implementation of the IED are found in the Best Available Reference (BREF) Notes. In all the BREF Notes, two fundamentally different approaches are presented:

- The reduction of existing emissions, i.e., a reactive approach, as can be implemented by Leak Detection and Repair (LDAR) programs, or
- the avoidance of emissions, i.e., a proactive approach.

In this context, ISO 15848-1 is important for the valve industry, because it enables the functional safety of valves to be classified regarding the reduction of volatile emissions. The type of test defined in this standard for the evaluation and qualification of valves is therefore a tool for the proactive implementation of the IED.

German regulations

In Germany, this approach is utilized in the first administrative regulation for the Federal Emission Control Law and the technical instructions for Air Quality Control (TA Luft); the new version is expected to come into effect in the autumn of 2021. In addition to the specifications for pumps, agitators, compressors, flanged connections and sampling points, the requirements in the regulation for shut-off and control valves play a central role in the processing, conveying, transferring, or storing of liquids. These reflect the advancements in measurement of fugitive emissions, and the new regulation goes well beyond the requirements of the current TA Luft.

ISO 15848-1

ISO 15848-1 represents a classification system and qualification procedure for the testing of valves. It specifies test procedures for the evaluation of the external leakage of stuffing box packings and housing cover connections of shut-off and control valves. The performance categories of tightness class, strength class and temperature class are defined as:

1. Tightness Class
- AH: ≤ 10^{-5} mg/m/s
- BH: ≤ 10^{-4} mg/m/s
- CH: ≤ 10^{-2} mg/m/s
- Housing Seal: ≤ 50 ppmv

The permissible leakage rate at the stem of the valves is based on the circumference of the shaft and is preferably measured using the vacuum method. For the test medium of methane, only the sniffing method is available to determine the leakage rate of the packings, and the tightness classes are as follows AM (≤ 50 ppmv), BM (≤ 100 ppmv), and CM (≤ 500 ppmv).

2. Strength Class

The number of mechanical cycles in connection with thermal cycles defines the strength class of the valve, whereby a distinction is made between shut-off (CO - full stroke) and control valves (CC - ± 10 per cent of the total stroke).

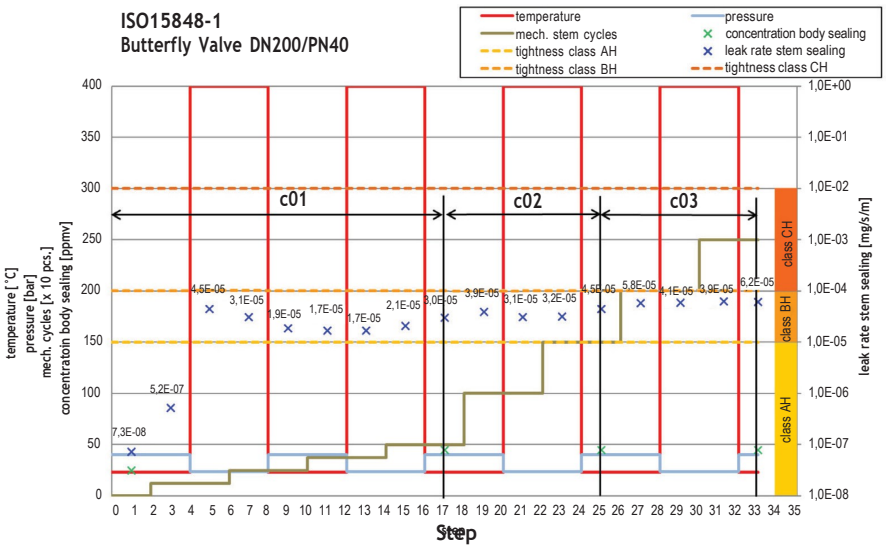


Figure 1: Testing a butterfly valve DN200/PN40 according to ISO 15848-1.

Table 1: Tightness requirements in the TA Luft 2021

	Test medium: Helium or methane	p ≤ 40 bar	p > 40 bar
T ≤ 200 °C	Packings	≤ 10^{-4} mg/m/s	≤ 10^{-2} mg/m/s
	Body Seal	≤ 50 ppmv	≤ 50 ppmv
T > 200 °C	Packings	≤ 10^{-2} mg/m/s	≤ 10^{-2} mg/m/s [1)]
	Body Seal	≤ 50 ppmv	≤ 50 ppmv

[1)] target

- CO1: 205 cycles with two temperature cycles
- CO2: an additional 1,295 cycles and one temperature cycle
- CO3: an additional 1,000 cycles and one temperature cycle

- CC1: 20000 cycles with two temperature cycles
- CC2: an additional 40,000 cycles and one temperature cycle
- CC3: an additional 40,000 cycles and one temperature cycle

An extension to additional strength classes can be achieved by repeating the test sequence of levels CO3 or CC3.
In each qualification step, a one-off readjustment of the set of packings back to the initial packing stress level is permitted if the desired tightness class cannot be achieved at the current stage. However, at the end of the test sequence, the leakage rates measured in all test steps must be below the permissible leakage rate of the specified tightness class.

Testing equipment TEMESvalve.teq for ISO 15848-1 tests.

1. Temperature Class
A total of six temperature classes are defined in ISO 15848-1, in which the valves are classified according to the test temperature.

- (t-196 °C): -196 °C to ambient
- (t-46 °C): -46 °C to ambient
- (t-29 °C): -29 °C to ambient
- (ambient): +5 °C to +40 °C
- (t200 °C): ambient to +200 °C
- (t400 °C): ambient to +400 °C

Of course, the tests can be carried out at any temperature. In such cases, the identification of the temperature class is simply supplemented by specifying the test temperature. For example, if the test temperature is 250 °C, then the valve is qualified at t200 °C, and the label is “t200 °C (250 °C)”.
Valves that have been qualified by a type test in accordance with ISO 15848-1, can be marked with a corresponding label. With this marking, the end-user can immediately see the performance category qualification.

TA Luft requirements

Within the TA Luft-regulation that was published in 2002, no specific tightness requirements were defined for valves. It was sufficient if the packing material or the set of packings were examined in a component test according to the specifications of VDI 2440 and the limit values were complied with.
These values were defined as 10^{-4} mbar·l/(m·s) for temperatures of up to 250 °C and 10^{-2} mbar·l/(m·s) for temperatures above 250 °C. This meant the packing material was qualified for use in TA Luft-applications. However, the entire valve was never tested, as this was not required.
Since only one temperature and one single leakage measurement at the test temperature were carried out for the packings in this component test, the leakage rates measured were not very informative regarding the actual sealing behavior in an industrial application. Likewise, the number of mechanical cycles in each component test was always determined individually, without any reference to an application of the valve.
For this reason, tests of different packing sets were almost never comparable with one another. The regulating body took these weak points into consideration when revising the TA Luft, and it now refers to the test procedures and test conditions defined in ISO 15848-1.

Valve prepared for testing.

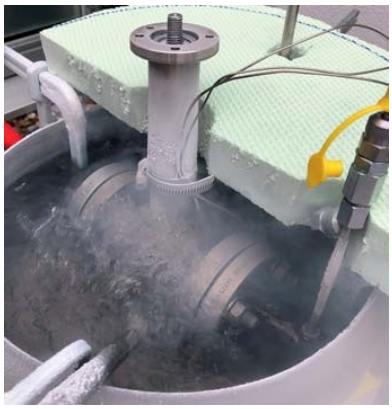
Test sequence

Regarding the test sequence, TA Luft does not contain any further or deviating specifications compared to ISO 15848-1. There are only specifications about the required tightness classes, as these are differentiated according to the temperature and internal pressure rating. The strength classes and temperature classes for the qualification of the valves for use in TA Luft-applications must correspond to those for use in industrial plants.
The highest tightness requirements apply to temperatures of up to 200 °C and internal pressures of up to 40 bar. The permissible leakage rate for this set of conditions is 10^{-4} mg/m/s (based on the circumference of the shaft), which corresponds to tightness class BH in ISO 15848-1, see also Table 1.
For applications with conditions outside of this range, compliance with the leakage

rate of 10^{-2} mg/m/s is required, which in turn corresponds to the tightness class CH in ISO 15848-1. For the rating above 200 °C and 40 bar, this tightness requirement is not intended to be a binding requirement, but rather as a goal to be striven for.

Test and maintenance instructions

Within new TA Luft it is explicitly allowed to qualify the valves using another medium, such as methane, or by another test method to prove the specific leakage rate of the sealing system.



Valve test under cryogenic conditions.

However, the limit values defined in Table 1 must always be adhered to. An assessment using the tightness classes BM or CM of ISO 15848-1 when using methane as the test medium is not provided. Since no separate stipulations are made in the updated TA Luft for the body seal connections, the requirement of compliance with the limit value of 50 ppmv can be assumed.
In addition to this qualification certificate according to ISO 15848-1, the plant operator needs test and maintenance instructions to ensure permanent tightness during the entire operating cycle. This is the only way to fully meet the requirements of the TA Luft. If the shaft bushings of the valve are designed as a metal bellow with a downstream safety stuffing box, no separate proof of compliance with the specified leakage rate is required. The requirement for test and maintenance instructions remains unaffected.

Complete test sequence

Figure 1 shows a complete test sequence for an ISO 15848-1 test. In over 30 test steps, a total of four temperature cycles and 2,500 mechanical cycles (1400 at ambient temperature and 1100 at 400 °C) were executed.
In the first leakage measurements, the tightness class AH could be achieved. In the following leakage measurements, the tightness class BH was achieved. Adjustments to the gland bolts were not necessary. According to the specifications of ISO 15848-1, the marking of this valve is “ISO FE BH – CO3 – SSA0 – t400 °C – (40/23.6) – ISO15848-1”.
For the use of the valve in industrial plants in which the specifications of the TA Luft must be met, this means an application limit of 400 °C at an internal pressure of 23.6 bar (in accordance with the tested p/T rating), since the permissible leakage rate of 10^{-2} mg/m/s was observed. Use of this valve at temperatures below 200 °C is also permitted, as the leak rate of 10^{-4} mg/m/s was also proven in the test according to ISO 15848-1.

About the author

Dr. Manfred Schaaf is CEO of amtec GmbH, based in Lauffen, Germany. Amtec is a leading company in testing services for valves and sealings with a subsidiary in Athens OH, USA. He is a member of several standardization committees in this area.