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## TEST CERTIFICATE

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**Materialprüfungsanstalt Universität Stuttgart**

Deutscher Akkreditierungs Rat
DAP - PL - 2907.99

# Test report

| | |
|---|---|
| Client: | Krasemann GmbH & Co. KG<br>Max-Planck-Str. 2<br>D-46414 Rhede |
| Order no. (client): | K120800891 |
| **Order no. (MPA):** | **902 4630 001 /Hh** |
| **Test object:** | **KRASO special sealing insert type SD30** |
| Test specification: | Measurement of the leakage rate |
| Date of receipt of the test object: | 04 September 2012 |
| Test date: | 05 to 06 September 2012 |
| Report date: | 12 September 2012 |
| Page 1 of | 6 pages of text |
| Supplements: | - |
| Appendices: | - |
| Total number of pages: | 6 |
| Number of copies: | 2 x Krasemann GmbH & Co. KG |

The test results relate exclusively to the test specimens.



The Materials Testing Institute of the University of Stuttgart is a test laboratory accredited by DAP Deutsches Akkreditierungssystem Prüfwesen GmbH pursuant to EN ISO/IEC 17025. The accreditation applies to the test methods listed in the certificates.





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## 1 Task

The aim of the examinations was to test the leak-tightness of a special sealing insert provided by the client. The sealing insert is used for the feeding of cables and pipes through house walls. In addition to the task of ensuring technical water-tightness, it should also be gastight as far as possible. In order to prove that, the leak-tightness of the sealing insert was to be determined.

Requirements for technical water-tightness can currently be found only in the nuclear rule KTA 3211.2 /1/, where tightness classes are defined for various media in nuclear technology. In the practical test, the absolute leakage rate (physical unit [mg/s]) is initially measured with a gaseous reference medium (usually helium or nitrogen). This leakage rate is divided by the average seal circumference (physical unit [m]). This results in the specific leakage rate with the physical unit [mg/(s·m)]. Compliance with tightness class $L_1$ means that the leakage rate is less than 1 mg/(s·m). If tightness class $L_1$ is complied with in the leakage test with a gaseous reference medium such as nitrogen, then the connection is technically watertight according to KTA 3211.2. $L_{0,1}$ stands for 0,1 mg/(s·m) and would be sufficient for technical leak-tightness with steam or compressed air etc. $L_{0,01}$ for 0,01 mg/(s·m) is the requirement for radioactive vapours. For the special sealing insert under examination, a sufficiently high safety distance to tightness class $L_1$ is to be proven.

## 2 Examinations carried out

The object of the examinations was the **KRASO special sealing insert type SD30** from Krasemann GmbH & Co. KG. The sealing insert consists of a rubber disc with a thickness of 30 mm. This is clamped between two stainless steel plates by means of threaded bolts, washers and nuts made of stainless steel. The threaded bolts are welded on one side to one of the steel plates and protrude through holes in the rubber disc and the other steel plate. Both steel plates and the rubber disc are provided with at least one more hole for the insertion of pipes or cables.

When clamped, the rubber disc is axially deformed between the steel plates, which leads to a change in its diameter and thus to a sealing force between the rubber disc and the surrounding wall casing/masonry and/or the inserted pipes and/or cables.

The sealing insert was clamped with a torque of 15 Nm per threaded bolt in a test fixture as shown in Fig. 1 and pressure was applied on one side with helium gas at a positive pressure of 2.5 bar.

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After a waiting time of about 15 minutes, the helium supply was shut off and the change of the internal pressure in relation to the measurement time was logged. The test took place at room temperature.

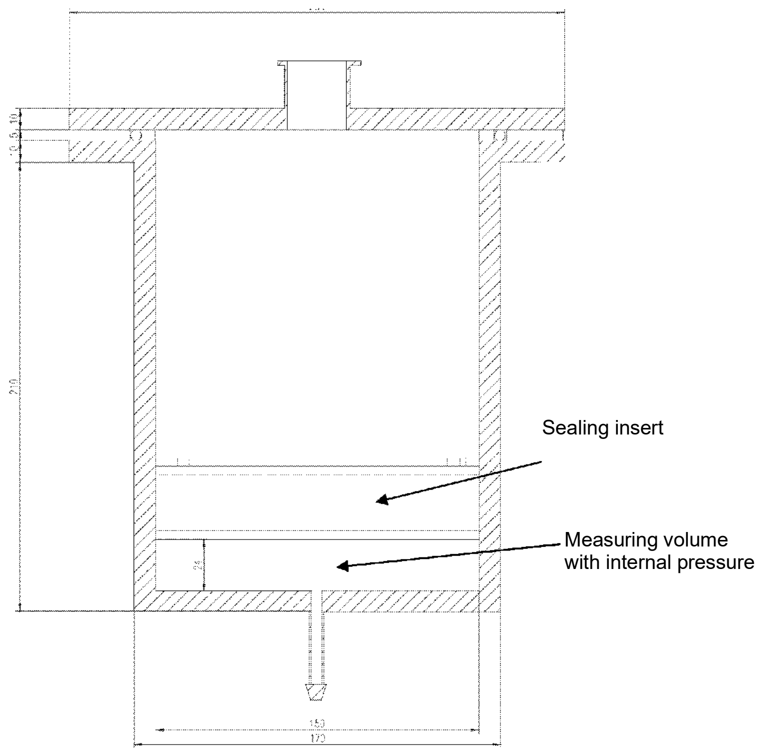


Fig. 1: Test setup for measuring sealing insert leakage

The recorded pressure drop is converted to a leakage rate according to equation (1) from DIN 28090-2 /2/, which was only slightly modified in comparison with the form published there. For the conversion to the specific leakage rate, the external diameter of 150 mm was taken to be the average seal circumference. The individual constants and variables in this equation are explained in Table 1.

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$$\lambda = \frac{\frac{V_M \cdot T_N}{p_N} \cdot \rho_{N_2}}{\pi \cdot D_m} \cdot \frac{\left|\frac{p_{t1}}{T_{t1}} - \frac{p_{t0}}{T_{t0}}\right|}{\Delta t} \quad (1)$$

| | Designation | Equation | Value | Unit |
|---|---|---|---|---|
| $V_M$ | Measuring volume | | 424 | [cm³] |
| $P_{t0}$, $P_{t1}$ | Pressure at time $t_0$, $t_1$ | | | [bar] |
| $T_{t0}$, $T_{t1}$ | Temperature at time $t_0$, $t_1$ | | | [K] |
| $T_N$ | Normal temperature | | 273.15 | [K] |
| $p_N$ | Normal pressure | | 1.013 | [bar] |
| $\rho_{He}$ | Density of helium | | 0.179 | $\left[\frac{mg}{cm3}\right]$ |
| $\rho_{N2}$ | Density of nitrogen | | 1.250 | $\left[\frac{mg}{cm3}\right]$ |
| $\lambda$ | Specific leakage rate | | | $\left[\frac{mg}{s \cdot m}\right]$ |
| $D_m$ | Average seal diameter | | 0.150 | [m] |
| $\Delta_t$ | Evaluation period | $\Delta_t = t_1 - t_0$ | | [s] |
| $t_0$ | Start time of measurement (evaluation) | | | [s] |
| $t_1$ | End time of measurement (evaluation) | | | [s] |

Table 1: Variables and constants in equation (1) for the conversion of pressure drop to leakage rate

The leakage rate described above is also known as the specific mass leakage rate. For a different assessment of the leakage rate, for example according to the German Technical Instructions on Air Quality Control (TA Luft) which, however, is meaningless in this context, the absolute volumetric leakage rate can be used. This is given by equation (2).

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$$\lambda_v = \frac{p_{t0} - p_{t1}}{t_{t0} - t_{t1}} \cdot V_M \tag{2}$$

If the volumetric leakage rate is divided by the average seal circumference, the result is the specific volumetric leakage rate.

### 3 Test results

A test pressure of 2.5 bar was initially applied. After 22.2 hours, the internal pressure had fallen by about 243 mbar. According to equation (1), the mass leakage rate for an internal pressure of 2.5 bar is thus 7.4 $10^{-5}$ mg/(s·m). The absolute volumetric leakage rate according to equation (2) is $2.1 \cdot 10^{-4}$ mbar·l/s. The specific volumetric leakage rate related to the seal circumference is $4.5 \cdot 10^{-4}$ mbar·l/(s·m).

The test result is valid only for the conditions in the test period.

### 4 Summary

The leakage behaviour of a special sealing insert for helium was examined with the aid of the pressure drop method. The test produced a specific mass leakage rate of $7.4 \cdot 10^{-5}$ mg/(s·m).

### 5 Interpretation of the result and recommendations[1]

In the examinations carried out, the leakage rate was so far below the permissible leakage rate according to /1/, which means the technical water-tightness, that it even lay below the limit value for radioactive vapours by a factor of more than 100. Although without meaning in this case, even the requirements according to TA Luft were almost met. The absolute leakage rate is only about 0.2 mm³ gas per second. Since the surrounding concrete will certainly have a considerably higher gas permeability than the sealing insert tested here, a very good sealing behaviour can be certified for the latter.

**signed D. Haidle**
**Sealing Technology Division**

**signed Dipl.-Ing. R. Hahn**
**Head of Sealing Technology Division**

[1] Opinions and interpretations are not subject to the accreditation

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## 6 Literature

/1/ KTA 3211.2: Pressure and activity retaining components of systems outside the primary circuit, part 2: Design and analysis Rule change draft proposal (3/2003)

/2/ DIN 28090-2: Static gaskets for flange connections - Part 2: Gaskets made from sheets; special test procedures for quality assurance (9/1995).