

Test Report

Subject: Estimation of the design working life of
REGUPOL vibration and **REGUFOAM vibration plus**
due to changes in natural frequency

Technical specification(s): ISO 11346:2023 (E)* and
ISO 23529:2016 (E)*

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1 Documents and standards

- [1] ISO 11346:2023 (E)* - Rubber, vulcanized or thermoplastic - Estimation of life-time and maximum temperature of use
- [2] ISO 23529:2016 (E)* - Rubber – General procedures for preparing and conditioning test pieces for physical test methods
- [3] DIN EN 1990:2021-10: Eurocode: Basis of structural design: German version EN 1990:2002 + A1:2005 + A1:2005/AC: 2010

2 Test specimens

1. Product I - REGUPOL vibration:

Mats made of elastomer-polyurethan-composite for active and passive vibration isolation and shock of flooring, machinery, buildings and civil engineering works.

The tests for estimation of the durability were carried out using the the following product types:
REGUPOL vibration 200, REGUPOL vibration 480 and REGUPOL vibration 1000

2. Product II - REGUFOAM vibration plus:

Mats made of poyurethan foam for active and passive vibration isolation and shock of flooring, machinery, buildings and civil engineering works.

The tests for estimation of the durability were carried out using the the following product types:
REGUFOAM vibration 150plus, REGUFOAM vibration 510plus and REGUFOAM vibration 990plus

3 Test information

Test performance period: August, 24, 2016 to November, 23, 2016

Specimen dimensions:

| | |
|------------------------------------|-------------------------|
| REGUPOL vibration 200: | 300 mm × 300 mm × 17 mm |
| REGUPOL vibration 480: | 300 mm × 300 mm × 15 mm |
| REGUPOL vibration 1000: | 200 mm × 200 mm × 10 mm |
| REGUFOAM vibration 150plus: | 300 mm × 300 mm × 25 mm |
| REGUFOAM vibration 510plus: | 300 mm × 300 mm × 25 mm |
| REGUFOAM vibration 990plus: | 125 mm × 125 mm × 25 mm |

Used exposure temperatures:

- +55 °C,
- +85 °C and
- +100 °C

A dynamic Zwick / Roell Amsler HA 100 testing machine acting as a single mass oscillator was used for determination of the natural frequency under static load.

Estimation of the design working life was carried out in accordance with ISO 11346:2023 (E)*.

4 Tests results, statement of conformity and interpretation

After removal from the heating cabinet, the test specimens were stored at ambient temperature for at least one day, and the natural frequency was determined subsequently. Taking into account the defined range of natural frequency tolerances (see Table 1), the point in time when the tolerance was exceeded in relation to the mean natural frequency at ambient temperature was documented, and the design working life was assessed in accordance with ISO 11346:2023 (E)* based on the change in natural frequency as an essential product characteristic.

Test results in accordance with ISO 11346:2023 (E)* are given in Table 1.

An example of the estimation of the design working life in accordance with ISO 11346:2023 (E)* is given in Annex A.

Table 1 Estimation of the design working life of the product types tested

| Type | Estimation of a design working life of at least 100 years related to a defined range of natural frequency tolerances ^{1) 2)} |
|--|---|
| Product I | |
| REGUPOL vibration 200 | pass |
| REGUPOL vibration 480 | pass |
| REGUPOL vibration 1000 | pass |
| Product II | |
| REGUFOAM vibration 150plus | pass |
| REGUFOAM vibration 510plus | pass |
| REGUFOAM vibration 990plus | pass |
| 1) Range of tolerances for all product types of REGUFOAM vibration plus: -30 % / +15 % (in relation to the average value of natural frequency at ambient temperature) | |
| 2) Range of tolerances for all product types of REGUPOL vibration: -10 % / +25 % (in relation to the average value of natural frequency at ambient temperature) | |

For buildings and other common structures, a design working life of 50 years has been determined in accordance with DIN EN 1990:2021-10. For reasons of economic efficiency and sustainability, however, buildings and supporting structures are increasingly being designed for a service life of 100 years. Based on the application of **REGUPOL vibration** and **REGUFOAM vibration plus** in active and passive vibration and shock isolation, sufficient natural frequency within the range of tolerances is crucial.

The estimation of the design working life of **REGUPOL vibration** and **REGUFOAM vibration plus** concerning the change in natural frequencies was carried out using three different product types (with

lowest, medium and maximum density. The load deflection and natural frequency are influenced significantly by the density of the product type. The selected product types hence represent the whole range of the products.

Based on the test results the estimation of the design working life of the product types listed in Table 1 applies to the whole range of **REGUPOL vibration** and **REGUFOAM vibration plus** products including all intermediate types (see Table 2).

Table 2 Estimation of the design working life of all product types of product I - REGUPOL vibration as well as product II – REGUFOAM vibration plus


| Product I – REGUPOL vibration | Product II – REGUFOAM vibration plus | Estimation of design working life |
|-------------------------------|--------------------------------------|-----------------------------------|
| REGUPOL vibration 200 | REGUFOAM vibration 150plus | > 100 years |
| REGUPOL vibration 300 | REGUFOAM vibration 190plus | |
| REGUPOL vibration 400 | REGUFOAM vibration 220plus | |
| REGUPOL vibration 450 | REGUFOAM vibration 270plus | |
| REGUPOL vibration 480 | REGUFOAM vibration 300plus | |
| REGUPOL vibration 550 | REGUFOAM vibration 400plus | |
| REGUPOL vibration 800 | REGUFOAM vibration 510plus | |
| REGUPOL vibration 1000 | REGUFOAM vibration 570plus | |
| | REGUFOAM vibration 680plus | |
| | REGUFOAM vibration 740plus | |
| | REGUFOAM vibration 810plus | |
| | REGUFOAM vibration 990plus | |

5 Summary

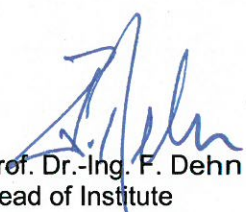
For estimation of the design working life of **REGUPOL BSW's REGUPOL vibration** and **REGUFOAM vibration plus** in accordance with ISO 11346:2023 (E)*, the change in natural frequency at different exposure temperatures was determined at regular intervals in accordance with ISO 23529:2016 (E)*.

The test results show an expected design working life of > 100 years for all types of product I – **REGUPOL vibration** as well as product II – **REGUFOAM vibration plus** within the given range of tolerances.

The test results relate only to the items tested.


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 Prof. Dr.-Ing. F. Dehn
 Head of Institute

**Exemplary the estimation of design working life for product type REGUPOL vibration 200
in accordance with ISO 11346:2023 (E)***

A.1 Procedure to estimate the design working life in accordance with ISO 11346:2023 (E)*

The estimation of the design working life in accordance with ISO 11346:2014 (E)* is based on at least three exposure temperatures chosen for conditioning of test specimens and determining the specific property on a regular basis. According to Figure A.1, the initial values of this product property are documented and the product property change with progressing time until exceedance of a limit value will be determined.

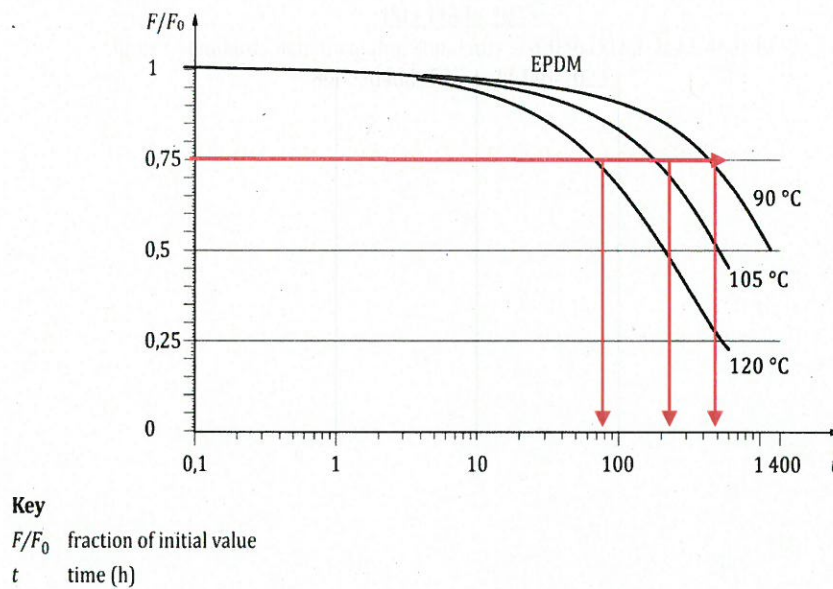


Figure A.1 Change in property against time as given in [1] as well as marking the times after which the tolerance limits were exceeded or not reached ($F/F_0 = 0.75$)

If the product properties exceed or fall below an upper or lower tolerance limit, this point in time is documented and transferred to a diagram with the reciprocal absolute temperature on the x-axis and the logarithmized reaction rate (time at which the tolerance is reached) on the y-axis (Arrhenius function). If the values determined lie on a straight line, an extrapolation can be made to estimate the durability of the products at +25 °C.

A.2 Test results of natural frequency under static loading at ambient temperature and after conditioning using three exposure temperatures for product type REGUPOL vibration 200 (exemplary)

The natural frequencies determined are given in Figure A.3. The upper and lower tolerance values are added for the product type **REGUPOL vibration 200** referring to the average value of the natural frequency at ambient temperature.

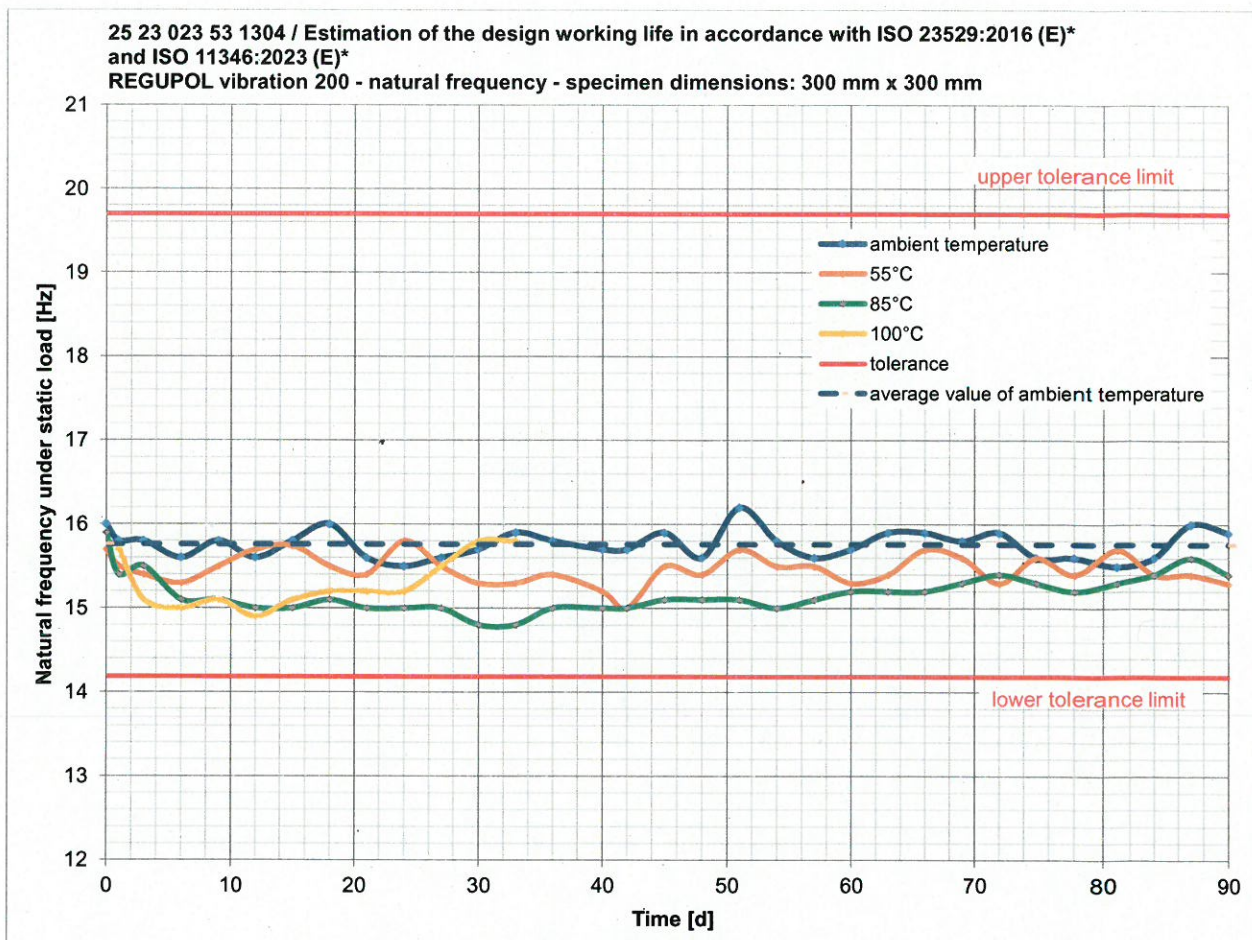


Figure A.2 Change in natural frequency at ambient temperature and three exposure temperatures

The change in natural frequency at ambient temperature and the three exposure temperatures exceed neither the upper nor the lower tolerance during the test. Taking into account the rules given in ISO 11346:2023 (E)*, this leads to the result that, considering the range of natural frequency tolerances, the design working life of **REGUPOL vibration 200** is > 100 years.