Fachverband Schaumkunststoffe und Polyurethane e.V.

# PUR Viscoelastic Foam

## Technical Specialist Group PUR Flexible Foam

VIS20160323 · As at 23.03.2016

## Introductory remarks

Within the foam families, there is a wide range of variants of PUR flexible foams, which can be optimally used for certain functions with regard to their respective properties. PUR viscoelastic foam has developed as a quality term for high-quality, pressure-sensitive, comfort applications.

The following description is intended to define the term viscoelastic foam more precisely by distinguishing it from standard PUR flexible foam in terms of both the raw materials used and the properties that characterise it.

The information in the product description PUR flexible foam as well as the material data sheet of the Technical Specialist Group PUR Flexible Foam also apply in full to PUR viscoelastic foam.

## The term viscoelastic foam

The term viscoelastic foam stands for the main characteristic of this foam class. Under pressure load and corresponding deformation, viscoelastic foams absorb and reduce a high proportion of the compressive forces. This process is called „stress relaxation“. With subsequent pressure relief, the viscoelastic foams return to their original form with a time delay (recovery time). They behave physically like a damped spring.

## Chemical-physical characterisation

The raw materials for PUR based on mineral oil are reacted with the use of certain additives. This produces the gas carbon dioxide, which causes the mixture to foam. The individual for-mulation and its components determine the properties of the finished foam – each quality has its own composition.

From a chemical point of view, PUR viscoelastic foam as well as standard PUR flexible foam is made from diisocyanate and polyalcohols in an exothermic polyaddition reaction using special catalysts, stabilizers and auxiliaries.

PUR viscoelastic foams are divided into two types:

- **Pneumatic viscoelastic foam**
- **Chemical viscoelastic foam**

To produce both types of viscoelastic foam, at least one special polyol in combination with special additives is required.


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By appropriate selection of these raw materials, the glass transition temperature, which is in the range of - 32°C for PUR flexible foam and PUR cold foam, is shifted into the temperature range ~ 0°C (pneumatic) or ~ 22°C (chemical). The glass transition temperature describes the transition from the elastic to the solid, non-elastic state of polymeric plastics.

Pure pneumatic viscoelastic foams have a high number of closed or microporous cells. Pure chemical viscoelastic foams, on the other hand, are open-cell. In many cases, both effects are combined in one viscoelastic foam.

At higher temperatures, viscoelastic foam becomes increasingly elastic, at low temperatures increasingly non-elastic and harder.

At normal ambient temperature (service temperature), the characteristic feature of viscoelastic foam is its ability to absorb and to a large extent reduce the applied pressure load. This effect, known as stress relaxation, which can be measured and quantified, is responsible for the pressure-relieving properties of viscoelastic foam.

## Characteristic properties

**1. Bulk density range/Hardness range**

PUR viscoelastic foams are produced in a bulk density range of 35 – 80 kg/m$^3$. The compression hardness (initial hardness after a loading cycle) varies between 1.0 and 4.0 kPa, depending on the intended application.

**2. Air permeability/Open-cell**

Depending on the foam system (pneumatic or chemical), PUR viscoelastic foam may only be open-cell to a limited extent. However, the degree of openness is not a sign of quality.

**3. Resilience**

The elasticity can be measured as rebound resilience according to DIN EN ISO 8307. In this process, a standardised steel ball falls onto the foam test piece from a defined initial height and bounces back. The rebound height is measured and expressed as a percentage of the initial height. The rebound or point elasticity of PUR viscose foam is a maximum of 15%.

**4. Comfort features**

The comfort features of PUR viscoelastic foam are largely determined by the parameters stress relaxation and recovery time.

Stress relaxation is the percentage ratio of the compressive force at initial loading (time 0 sec.) to the compressive force after a loading time of 180 sec. and thus indicates the ability of the PUR viscoelastic foam to relieve pressure. Good viscoelastic foams achieve a stress relaxation of at least 50%.

The recovery time as a visible characteristic for pressure relief of a viscoelastic foam should be in the range of 9 sec. +/- 4 sec.


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## Fields of application

Due to its special pressure-relieving comfort properties, PUR viscoelastic foam is particularly suitable for pads (4 – 6 cm), in the production of mattresses and as a solid material for pillows.

However, many of the advantageous mechanical properties also depend on the density of the material, in particular the preservation of these properties over the entire product life.

For mattresses, the density should therefore be at least 45 kg/m³, for pillows densities of 35 kg/m³ are recommended due to the lower load.

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This DOCUMENT was developed in the Specialist Association Foamed Plastics and Polyurethanes by the Technical Specialist Group PUR Flexible Foam.

Fachverband Schaumkunststoffe und Polyurethane e.V.

Brussels • Frankfurt • Stuttgart
*Postal adress:* Stammheimer Straße 35 • D-70435 Stuttgart
Tel. +49 711 993 751-0 • **www.fsk-vsv.de** • fsk@fsk-vsv.de

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