FreChem GmbH & Co. KG
FIPFG – Instructions for a Suitable Design

Contents

Advantages of a FIPFG Suitable Design

- Good sealing result
- Depending on componant, any IP class is possible
- High efficiency
- Little waste
- High process stability
- Reproducibility
- Multiplicity of potential applications
- High production speed

Technical Key Data for PU soft foams

Shore 00 / A	10 – 80 / 3 – 45
Strength	150 – 500 kPa
Elongation	50 – 200 %
Compression Set 22 h / 70 °C / 50 %	3 - 15 %
Water absorption	
hydrophobe systems	< 5 %
standard	5 to 15 %
Temperature resistance	duration: - 40 to +80 short: -60 to +160 °C
Liquid systems	900 – 5,000 mPa*s
Semi-thixotropic	15,000 – 35,000 mPa*s
Thixotropic	35,000 – 80,000 mPa*s
Highly thixotropic	> 80,000 ... ~

PU Soft Foams - Facts

- Mixed cellular structure, therefore lower compression stress than in contained systems
- PU soft foams will cure at room temperature; no need to anneal them
- UL50e and UL94 are possible
- Recommended compression degree 30 – 60 %, depending on the soft foam used as well as on the sealing requirements and component design
- Continuous temperature exposure of between -40 and +80 °C
- Higher temperatures, under simultaneous pressure, will result in a mechanical destruction of the innner cell structure
- Avoid high component tolerances to ensure an even compression throughout the whole gasket contour
- Groove and knife constructions require less compression stress than flat surfaces

Compression Set (DVR)

The permanent deformation (=compression set) of flexible PU foams and elastomers is determined after a constant deformation over a period (22 hours) at a constant temperature of 70 °C (in accordance with EN ISO 815 DIN 53517).

Calculation DVR:

h0 = 10 cm

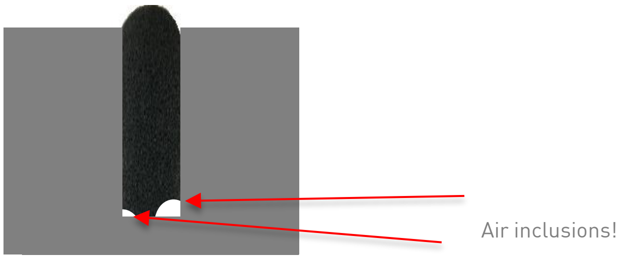
h1 = 9.6 cm

$$DVR = \frac{h0 - h1}{h0} * 100\,\%$$

$$DVR = \frac{10\text{ cm} - 9.6\text{ cm}}{10\text{ cm}} * 100\,\% = 4\,\%$$

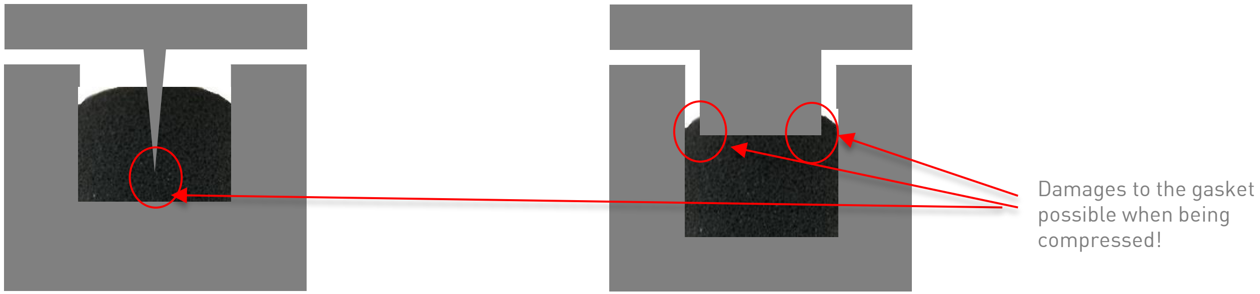
Groove and Knife Design

- Liquid systems facilitate interfacing the start and end points.
- Due to the relative tolerances of component and gasket, a minimum width of 2.5 mm should be provided for the gasket.
- The groove should be constant throughout the whole contour to ensure an even height of the gasket's surface.
- No edges or undercuts within the groove geometry, since air inclusions may cause an irregular appearance of the gasket.
- The ratio of groove depth to width should preferably be between 1:1 and 2:1. In case of a ratio of 3:1 and more, air inclusions can occur.



Sealing with a Spring

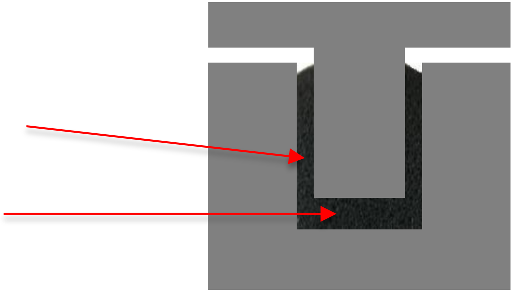
- Counterparts which are too sharp or pointed will destroy the gasket



Sealing with a Spring

- The width of the spring should not exceed 1/3 of the total width of the groove, since this may tear off the gasket along the wall.
- Excessive compression (> 60 %) may also cause damages to the gasket (incisions).

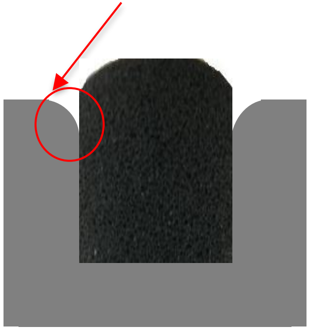
Damages to the gasket possible when being compressed!



Sealing against a Surface

- Avoid sharp edges and recesses

Better: slightly rounded edges

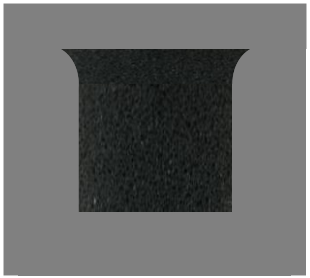


Sharp edges can cause damages to the gasket

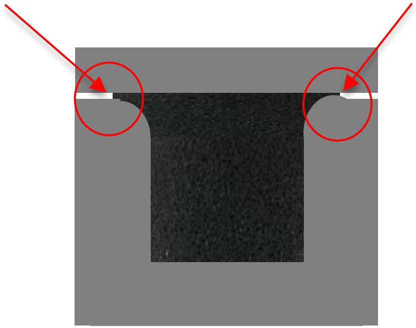
Sealing against a Surface

- The gasket must not protrude the groove by more than 1/3 of the gasket's total height. Otherwise tears and squashings might occur when being compressed.
- To accomodate the sealing requirements in this case, we recommend to make use of more compact systems requiring a lower compression strength.

Optimum finish/compression



Sealing foam is sqashed and mechanically destroyed

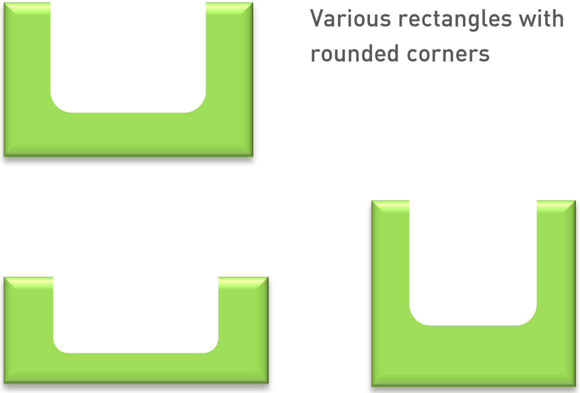


Groove and Knife Design

Semicircle

Ellipse

Semicircle with laterally lifted walls



Various rectangles with rounded corners

Groove and Knife Design

Unsuitable Groove Geometrics

Flat Surfaces

- In the case no groove is available in the component, semi-thixotropic to highly thixotropic systems are used.
- The viscosity of the sealing material depends on two aspects:
  - height differences in the sealing line
  - required width/height ratio
- Due to the component and gasket's relative tolerances, a minimum width of 2.5 mm should be provided for the gasket.
- A direct compression along the wall should be avoided as this may result in tears and damages to the gasket.

Flat Surfaces

The general rule is: The higher the viscosity, the slimmer the gasket and the higher the height/width ratio.

Semi thixotropic

Viscosity	15,000 – 40,000 mPa*s
Height-/width ratio	1:3 to 1:2

Standard thixotropic

Viscosity	40,000 – 90,000 mPa*s
Height-/width ratio	1:2

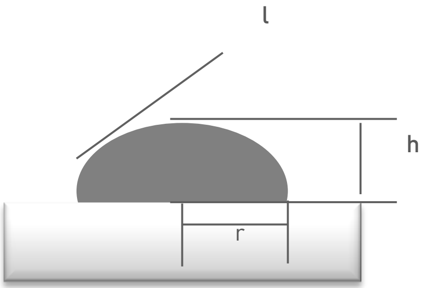
Highly thixotropic

Viscosity	90,000 – 200,000 mPa*s
Height-/width ratio	1:2 to 1 : 1.5

Influences on Adhesion

		Advantage	Attention!
•	**Cleansing**	Fats and other residuals are removed	-
•	**Thermal**	Residuals are burnt, surface is roughened	Waxes and other substances of the substrate may migrate to the surface
•	**Mechanical**	Increase in height of surface (in liquid systems)	Reduction of the contact surface (in thixotropic systems)
•	**Chemical**	Changing of the surface structure	Depending on material and primer
•	**Plasma**	Activation of the surface on account of open chemical bonds	Overloading the surface

Calculation of gasket quantity required on a flat surface



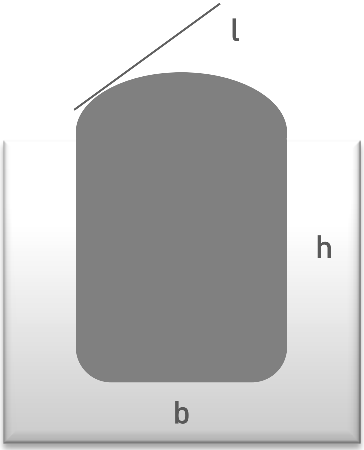
r:	Radius of gasket
A:	Surface of gasket
δ	Volume weight of gasket
l:	Length of gasket

$$\text{Weight}_{\text{flat}} = \frac{1}{2} * \pi * r^2 * A = \pi * r^2 * l * \delta$$

r = 0.6 cm
l = 120 cm
δ = 0.35 g/ccm

$$\text{Weight}_{\text{flat}} = \frac{1}{2} * \pi * 0.6\ \text{cm}^{\ 2} * 120\ \text{cm} * 0.35 \frac{\text{g}}{\text{cm}^3} = 39.56\ \text{g}$$

Calculation of gasket quantity in a groove



h:	Height of gasket
b:	Width of gasket
δ	Volume weight of gasket
l:	Length of gasket

$$\text{Weight}_{\text{groove}} = \text{h} * \text{b} * \text{l} * \delta$$

h =1.2 cm
b = 0.7 cm
l = 120 cm

$$\text{Weight}_{\text{groove}} = 1.2\ \text{cm} * 0.7\ \text{cm} * 120\ \text{cm} * 0.35\ \frac{\text{g}}{\text{cm}^3} = 35.28\ \text{g}$$

Legal Advice

This instruction manual constitutes a general guideline. It is based on our knowledge gained and experiences made in the polyurethane chemical industry. Users are not exempt from their duty to conduct their own tests and trials.

A legally binding warranty for any particular application cannot be derived from this instruction manual. Possible proprietary rights as well as existing laws and regulations shall be observed.

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