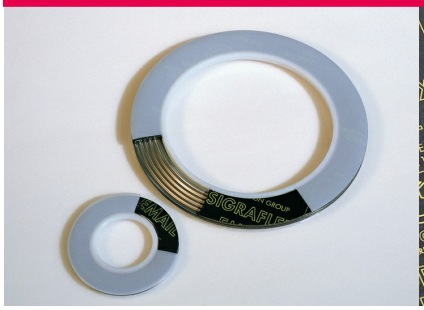
SIGRAFLEX® EMAIL



Multilayer sealing sheet, adhesive-free made from flexible graphite foil reinforced with stainless steel foils especially for use in PTFE envelope gaskets

SIGRAFLEX® EMAIL has been developed specially for use in PTFE envelope gaskets.

SIGRAFLEX® EMAIL is a multilayer sealing sheet made from flexible graphite foil (type Z), which is reinforced with two 0.05 mm thick stainless steel foils.

SIGRAFLEX® EMAIL is manufactured in total sheet thicknesses of 2 and 3 mm. SIGRAFLEX® EMAIL with a thickness of 2 mm comprises two outside flexible graphite layers, 0.5 mm thick, and one flexible graphite inner layer, 1.0 mm thick, with a density of 1.1 g/cm^3. The SIGRAFLEX® EMAIL sheet material with a thickness of 3 mm comprises three layers of 1.0 mm thickness with a density of 1.1 g/cm^3. The overall composite is produced by a special process which uses no adhesive. It can thus meet extreme demands for mechanical strength at elevated temperatures.

Applications

- Primarily as an asbestos-free soft core material with improved properties for PTFE envelope gaskets in enameled pipe work, vessels, stub connections and access apertures.
- For PTFE envelope gaskets in steel pipework with increased demands for operational reliability, impermeability and product purity (aggressive media presenting health hazards; service media listed under the German Clean Air Regulations, Class 1; pharmaceutical industry).

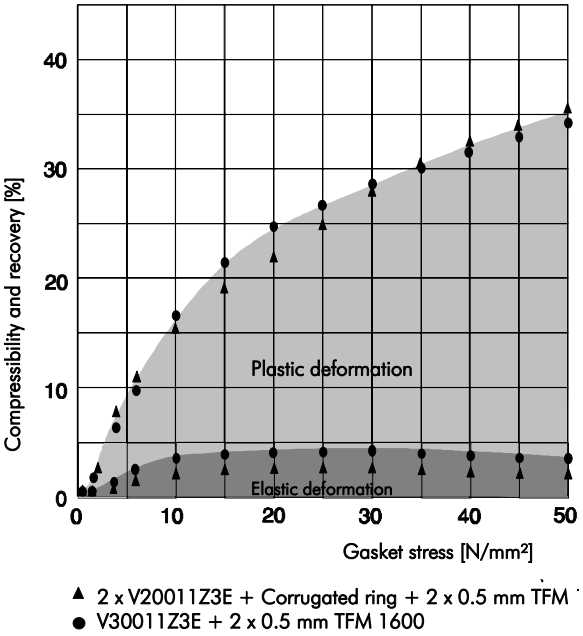
Properties

The graphite's good recovery behavior, the stainless steel foil reinforcements and the adhesive-free joining of the individual layers have together improved the sealing properties of PTFE envelope gaskets substantially:

- Despite the influence of flow processes in the PTFE the graphite foil layers are prevented from sliding away from the smooth metal reinforcements due to the special bonding technique.
- The good recovery behavior of flexible graphite even at high temperatures can compensate for cold and warm flow characteristics specific to PTFE.
- Owing to the excellent chemical resistance, high thermal stability and good sealing properties of this optimized core material, good leak-tightness is maintained even if the PTFE enveloping is damaged.
- Excellent bursting safety due to the double metal reinforcement.
- Great adaptability and hence good gasket stress distribution as a result of the flexible graphite's good compressibility without risk of damage to enameled component even if flanges are destroyed.
- Long-term stability of recovery and compressive behavior which allows the manufacture of PTFE envelope gaskets requiring a minimum of retight-

ening.

- Good handling properties as a result of high rigidity and mechanical strength.
- Excellent punching properties.
- Asbestos-free, presents no health hazard
- Minimal ageing of the gasket system (PTFE/ graphite/stainless steel).



Forms supplied

SIGRAFLEX® EMAIL sheets are available in the following dimensions:

Dimensions [mm]:	Type:
1500 x 1500 x 2.0	V20011Z3E
1500 x 1500 x 3.0	V30011Z3E

Recommended design of PTFE envelope gaskets

The following design principles are based on a sealing system developed jointly with the leading companies in the chemical industry. For SIGRAFLEX® EMAIL gaskets, the following quality criteria have been established:

- Optimum impermeability thanks to PTFE enveloping
- Good sealing properties even if the PTFE enveloping is damaged
- Minimum need for retightening (reloading normally unnecessary, but possible)
- Max. service temperature 230 °C (depending on service pressure)
- Good long-term recovery behavior
- Robust handling properties
- Favorable price/performance ratio
- Low overall costs (gasket, installation, reloading)
- Bursting and blow-out safety

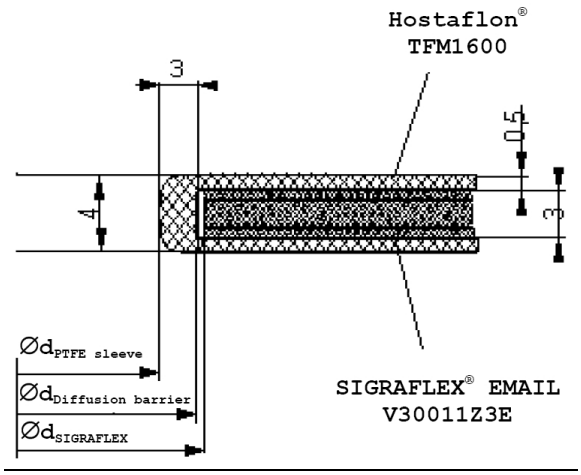
Up to a diameter of 200 mm, PTFE envelope gaskets are designed without corrugated ring, in a thickness of 4 mm, incorporating a 3 mm thick soft material layer in SIGRAFLEX® EMAIL. For larger diameters, the following recommendations are given:

DN	Corrugated ring	Sift material layers
≤ 200	-	1 x 3 mm
250 – 450	1	2 x 2 mm
500 – 800	1	2 x 3 mm
> 800	1	4 x 2 mm*

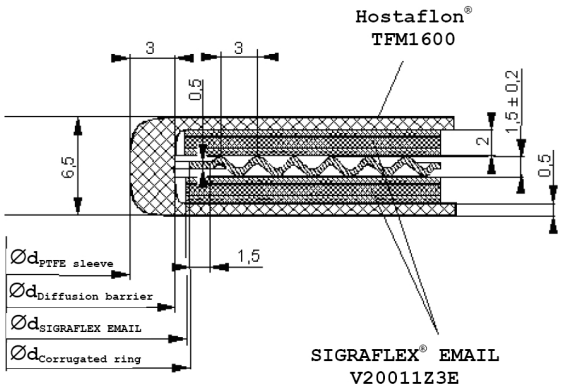
* overlapped design

- Where flange distortions exceed 0.5 mm, the area between corrugated ring and graphite top layer is filled with SIGRAFLEX® STANDARD segments
- The corrugated ring should be manufactured from 0.5 mm thick stainless steel sheet 1.4571 with a corrugation width of 3 mm and a height of 1.5 mm. It should be free from burrs. Where it reaches the inside edge of the ring, the corrugation should be at the mid-point between the two outer layers
- The PTFE-enveloping should be rounded off at the inside edge and a diffusion barrier of at least 3 mm should be incorporated. The recommended thickness of the enveloping is 0.5 mm.

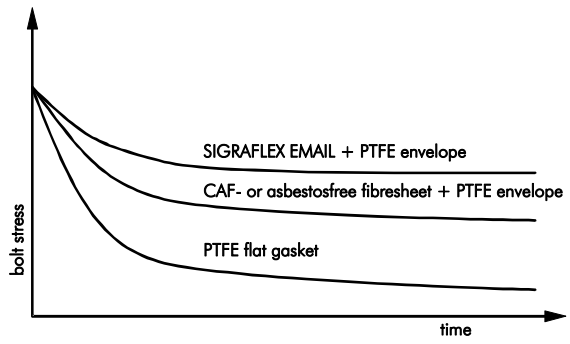
Recommended design for diameters up to 200 mm:



Recommended design of PTFE envelope gaskets with a diameter of 250 to 450 mm:



The soft material layer based on flexible graphite increase the life-time properties of the complete PTFE envelope gasket (figure).



Installation instructions

- The sealing faces must be clean, dry and free from grease. Gaskets must be undamaged. No release agents should be used.
- During installation, the flanges should be aligned centrically, as otherwise leakage may occur as a result of misalignment, especially at enameled, convex sealing faces. The flanges should be aligned parallel. Flange bolts should be tightened in an alternate order, first to approx. 50 % of the maximum torque value, in the second stage to approx. 80 % and to the full value in the third stage but not before. All bolts must be tightened to the specified value. Where flange distortions exceed 0.5 mm, SIGRAFLEX® STANDARD should be used for filling. This is described in our technical information sheet "Installation instructions for segmented gaskets", which can be supplied on request.
- As a result of the cold and warm flow characteristics of the PTFE enveloping, bolt loading declines after installation and changes in temperature. Under certain service conditions it is therefore recommended that the bolts be re-tightened to the specified values. It is recommended as a general rule that the bolts be re-tightened at temperatures above 100°C (re-tightening at room temperatures!). This is not necessary where internal pressure is low and thermal stresses are minor.
- The application range of PTFE envelope gaskets is governed by the mechanical properties of enameled flanges, because the load-bearing capacity of enameled flanges is not very high, the manufacturers of enameled vessels and pipe work recommend relatively low gasket stresses.
- The manufacturers of enameled vessels give specific recommendations for tightening and retightening. The max. admissible torque values for enameled flanges specified by these manufacturers must always be adhered to. Exceeding these values may result in damage to the enamel layer and consequent loss of claims under the guarantee.

Our detailed assembly instructions are available on request.

SIGRAFLEX® EMAIL

Material data of SIGRAFLEX® EMAIL sheet material

Material type			V20011Z3E	V30011Z3E
Thickness		mm	2	3
Bulk density of graphite		g/cm³	1.1	
Ash content of graphite (DIN 51903)		%	≤ 0.15	
Reinforcing steel foil details				
Material DIN code number			1.4401	
Thickness			0.05	
Number of foils			2	
Gas permeability				
DIN 3535 Part 4		cm³/min	< 0.8	< 1.0
DIN 28090 Part 1		mg/(s·m)	< 0.08	< 0.1
Residual stress (DIN 52913) $\sigma_{D\ 16h,\ 300\ °C,\ 50\ N/mm^2}$		N/mm²	> 48	
Gasket factors (DIN E 2505) Gasket width b_D = 20 mm				
σ_{VU}		N/mm²	20	20
σ_{VO}		N/mm²	130	120
$\sigma_{BO;\ 300\ °C}$		N/mm²	110	100
m			1.3	
Compression factors (DIN 28090-2)				
Compressibility	ε_{KSW}	%	30 - 40	
Recovery at 20 °C	ε_{KRW}	%	4 - 5	
Hot creep	ε_{WSW}	%	< 4	
Recovery at 300 °C	ε_{WRW}	%	3 - 4	

Definitions

σ_{VU} Minimum gasket assembly stress.
(The given minimum assembly stresses apply to a sealing criterion as previously used for compressed asbestos fibre seals. To reduce the rate of leakage, we recommend a higher gasket stress. See brochure SIGRAFLEX® Products manufactured from flexible graphite foil).

σ_{BU} Minimum gasket assembly stress in service, where σ_{BU} is the product of internal pressure p and gasket factor m for test and service conditions ($\sigma_{BU} = p \cdot m$)

σ_{VO} Maximum permissible gasket stress at 20 °C

σ_{BO} Maximum permissible gasket stress in service

m $m = \sigma_{BU} / p_i$

ε_{KSW} Compression set under a gasket stress of 35 N/mm²

ε_{KRW} Gasket recovery after reduction in gasket stress from 35 N/mm² to 1 N/mm²

ε_{WSW} Gasket creep compression under a gasket stress of 50 N/mm² at 300 °C for 16 h

ε_{WRW} Recovery after reduction in gasket stress from 50 N/mm² to 1 N/mm²

The percentage changes in thickness of ε_{KSW}, ε_{KRW}, ε_{WSW} und ε_{WRW} are relative to the initial thickness.

Material data of PTFE envelope gaskets in accordance with our design recommendations

Material type				
Soft material core			**V30011Z3E**	**2 x V20011Z3E**
PTFE envelope			**Hostaflon® TFM 1600**	**Hostaflon® TFM 1600**
Corrugated ring			**-**	**1.4571**
Total thickness		mm	4.0	6.5
Gas permeability				
DIN 3535		cm^3/min	< 0.01	
DIN 28090 Part 1		mg/(s·m)	< 0.001	
Residual stress (DIN 52913)		N/mm²		
$\sigma_{D\ 16\ h;\ 150\ °C;\ 30\ N/mm^2}$			≥ 16	≥ 14
Gasket factors (DIN E 2505)				
Gasket width b_D = 20 mm				
σ_{VU}		N/mm²	8	8
σ_{VO}		N/mm²	60	80
$\sigma_{BO;\ 200\ °C}$		N/mm²	50	50
m			1.1	
Compression factors (DIN 28090-2)				
Compressibility	ε_{KSW}	%	30 - 40	30 - 40
Recovery at 20 °C	ε_{KRW}	%	3 – 4	2 – 3
Hot creep	ε_{WSW}	%	5 – 6	4 – 5
Recovery at 300 °C	ε_{WRW}	%	2 - 3	2 – 3

03 2011/0 2NÄ Printed in Germany

Graphite Specialties | SGL CARBON GmbH
Phone +49 8271 83-2276 | expandedgraphite@sglcarbon.de
www.sigraflex.eu | **www.sglgroup.com**

SGL GROUP
THE CARBON COMPANY