TESNIT® BA-SOFT

An Advanced Sealing Material for Current Innovative Machinery

DONIT®
A perfect fit

In our contemporary 21st -century constantly evolving world governed by stricter government regulations, energy saving, efficient use of resources and sustainability are the norm. This is strikingly noticeable in our daily life and in various industrial sectors with novel products such as pumps, compressors, valves and gearboxes, embodying progress in construction design and composition. In particular, lightweight mechanical systems envisioned for sparing energy call upon new building materials, and "cover-and-pot" systems are a pertinent example of this trend.

Spiking challenges in the Sealing Gaskets Sector

The housing (cover-and-pot) of mechanical machinery if made from diverse panoply of metals (e.g. cast iron, aluminum, aluminum-magnesium alloys) are prone to deformation under coupled temperature and mechanical forces. This forces designers to attenuate this effect e.g. by incorporating reinforcements in the construction.

For example, "cover-and-pot" construction systems suffer from the following:

- deficient stiffness of the cover and/or housing
- broad spacing between the adjacent connection bolts especially in complex housing geometries
- low allowable bolting force.

Due to these problems a non-uniform and inadequate surface pressure on the gasket results, leading inevitably to leakage during either the assembly or operation. Despite the progress in constructions adaptation in view to circumvent such weak-points or flaws, the necessity to hermetically seal the system especially at the cover level remains. Resorting to Finite Element Method (FEM) analysis, Figure 1 illustrates the resulting overall deformation from the applied stress in the case of a standard steel flanges connection as in pipelines. This study exemplifies also the occurring stress and its consequence in the case of other types of mechanical construction, geometry and material. For example, for a given device construction, the deformation can be significant depending on its design and building-material. For a reliable and smooth operation, an Advanced Sealing Material is needed which properties have to meet all the specific requirements imposed by the application.

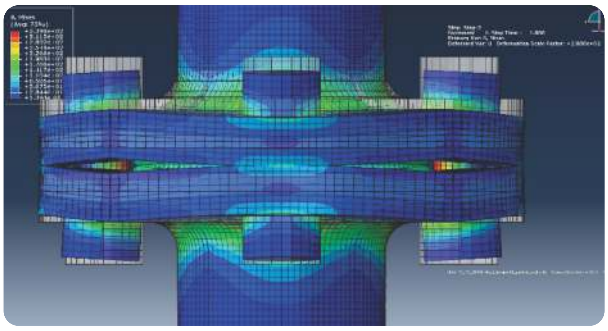


Fig 1: FEM analysis of the stress applied onto a steel flanges assembly.

An additional gasket material challenge arises when the design necessitates a sealing gasket with a narrow web width. Therefore, a sufficiently dimensionally-stable and good thermo-mechanically performing material is required for large-diameter gaskets. Under fluctuating operating conditions, such gasket material ensures tightness, functionality and safety.

A Perfect Adaptability to Seal

The major source of observed leakage in assemblies is at the interface between the gasket and the flanges (i.e. the cover and the pot). A through-the-material (cross-sectional)

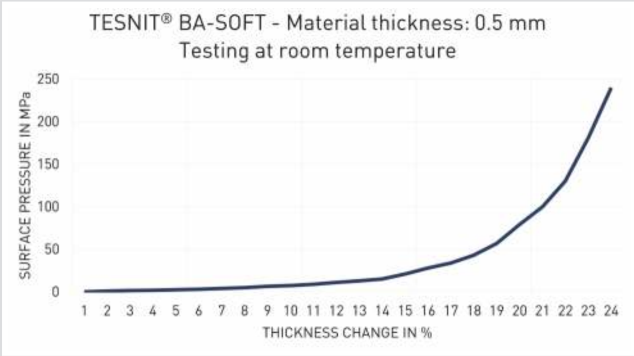


Fig. 2: TESNIT® BA-SOFT compressibility (at room temperature) according to DIN 28090-1.

gasket leakage is only likely with poor medium chemo-resistance or incompatibility.

Figure 2 displays the compression curve of TESNIT® BA-SOFT material at room temperature. This material exhibits a high compressibility, therefore a high adaptability to flanged surfaces in applications.

The compressibility/adaptability of TESNIT® BA-SOFT is in the order of approximately 4-times greater than that of common standard fiber-based gasket materials (figure 3) demonstrating the outperformance of the former.

Note that the gasket material possessing the highest compressibility/adaptability under identical surface pressure provides the highest sealability.

Even with a 30% reduced surface pressure, a tight seal can be established using TESNIT® BA-SOFT material while classical materials would fail causing the equipment part to malfunction. Therefore, TESNIT® BA- SOFT is a tolerant material that lowers and eliminates the risk of leakage.

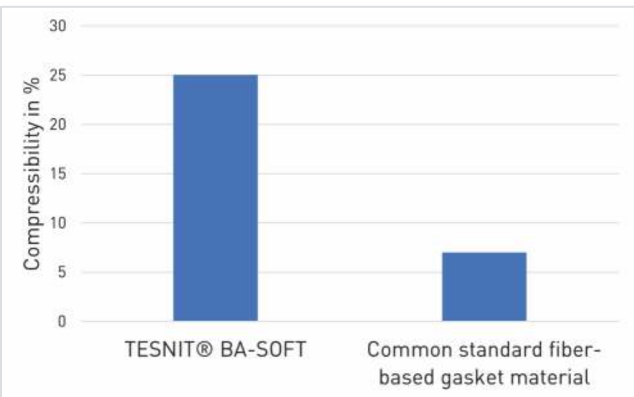


Fig. 3: TESNIT® BA-SOFT compressibility compared to a common standard fiber-based material according to ASTM F36J.

Figure 4 demonstrates the superiority of TESNIT® BA- SOFT material (A) to conform to the sealing surface of a complex mechanical construction compared to a common standard fiber-based gasket material (B). Their load distributions and surface contacts are visualized by the Fujifilm test.

Material (B) shows just a small portion of the central area in blue (i.e. a partial surface contact is established), while the rest of the available area is basically white (i.e. no contact nor surface pressure and thus leakage). While with TESNIT® BA-SOFT (A), this one is in full contact with the gasket and the entire sealing area is at an acceptable range of surface pressure.

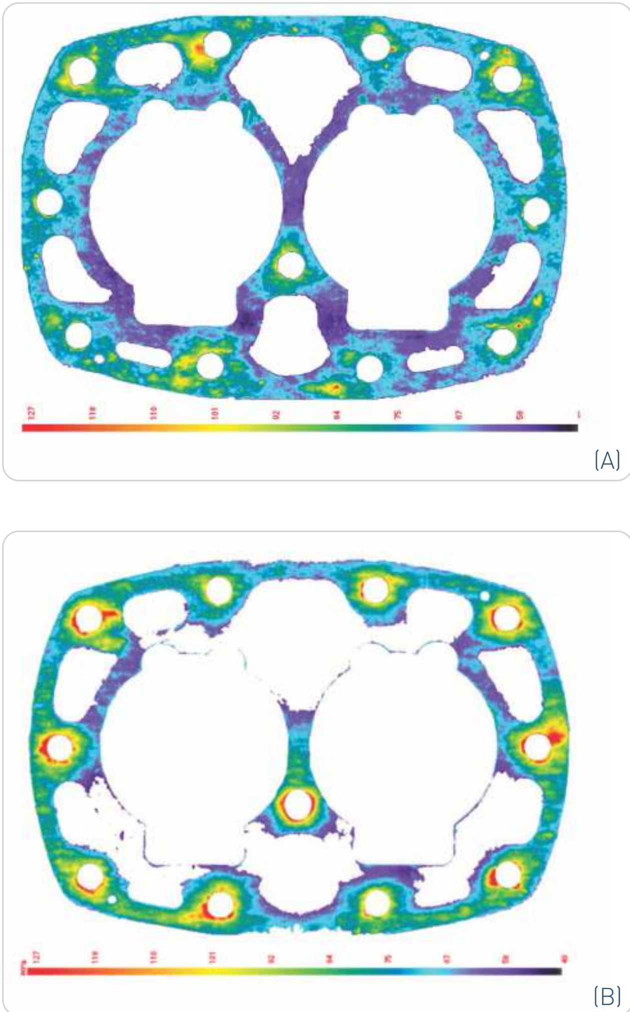


Fig. 4: Gasket surface pressure distribution visualized by the Fujifilm test under identical loading on gaskets cut from TESNIT® BA-SOFT (A) and a common standard fiber-based material (B). (A) is advantageous vs. (B) displaying a good full contact (i.e. a tight seal) across all the required contact area including the central one.

TESNIT® BA-SOFT gasket material in this system reduces significantly the risk of surface leakage - all other installation conditions (as bolting load) remain unchanged.

Thermomechanical-strength guarantees long-term performance

In addition to adaptability, Advanced Sealing Materials should be characterized by outstanding thermo-mechanical stability. In order to ensure full performance under working conditions, such as elevated temperature and fluctuating mechanical load, adaptability should not be achieved at the expense of thermo-mechanical stability. Figure 5 shows the Hot Compression Test (HCT) curves for TESNIT ® BA-SOFT (in yellow) versus two commercial highly compressible fiber-based gasket materials (in blue and in red).
Over a wide temperature range, displaying much reduced deformation and thickness decrease, TESNIT® BA-SOFT emerges as the best material in this test as it conserves its structural integrity.

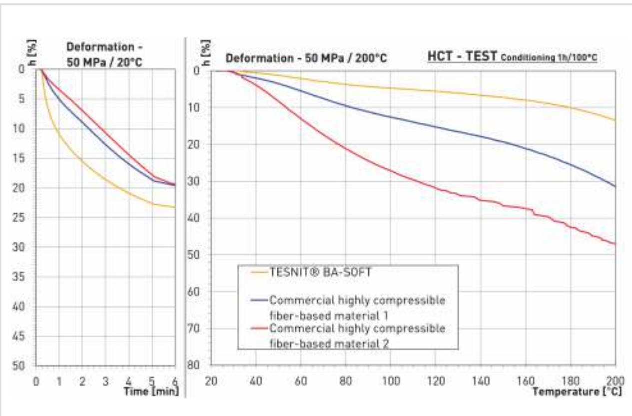


Fig. 5: HCTs of gaskets cut from TESNIT® BA-SOFT and two commercial highly compressible fiber-based materials. Overall, TESNIT® BA-SOFT is clearly advantageous displaying a good thermo-mechanical property.

Lacking this property, other gasket materials would lead to an attenuation in bolts´ load (i.e. decreased surface pressure) which translates into gasket failure as by leakage or blow-out.

In CONCLUSION, TESNIT® BA-SOFT gasket material is an exemplary advanced highly compressible fiber-based gasket material which was specially formulated at DONIT to match the modern mechanical applications` requirements; these wherein adaptability to the assembly connection-surfaces deformities or defects is allied to a sufficient thermo-mechanical performance. These two seemingly antagonistic properties go here hand-in-hand.

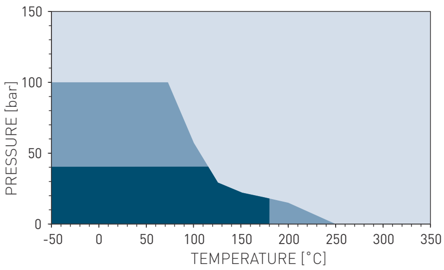
TESNIT® BA-SOFT gasket material fits perfectly the bill of machinery for various types of industry; it is reliable and guarantees their safe operation.

TECHNICAL DATA Typical values for a thickness of 2 mm

Density	DIN 28090-2	g/cm^3	1.5
Compressibility	ASTM F36J	%	25
Recovery	ASTM F36J	%	64
Tensile strength	ASTM F152	MPa	6
Stress resistance	DIN 52913		
50 MPa, 175°C, 16 h		MPa	30
50 MPa, 300°C, 16 h		MPa	20
Specific leak rate	DIN 3535-6	mg/(s·m)	0.009
Thickness increase	ASTM F146		
Oil IRM 903, 150°C, 5 h		%	2
ASTM Fuel B, 23°C, 5 h		%	6
Compression modulus	DIN 28090-2		
At room temperature: ε_{KSW}		%	18.4
At elevated temperature: $\varepsilon_{WSW/200\,°C}$		%	14.6
Creep relaxation	DIN 28090-2		
At room temperature: ε_{KRW}		%	10
At elevated temperature: $\varepsilon_{WRW/200\,°C}$		%	1.6
Max. operating conditions			
Peak temperature		°C/°F	350/662
Continuous temperature		°C/°F	250/482
- with steam		°C/°F	200/392
Pressure		bar/psi	100/1450

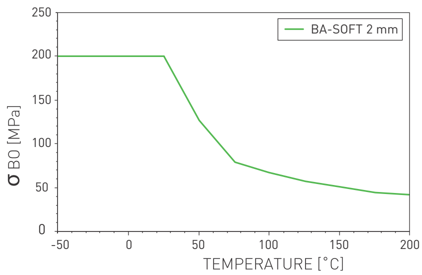
P-T DIAGRAM

EN 1514-1, Type IBC, PN 40, DIN 28091-2 / 3.8, 2.0 mm



σ_{BO} DIAGRAM

DIN 28090-1



P-T diagram indicates the maximum permissible combination of internal pressure and service temperature which can be simultaneously applied for a given gasket's thickness, size and tightness class. Given the wide variety of gasket applications and service conditions, these values should only be regarded as a guidance for the proper gasket assembly. In general, thinner gaskets exhibit better P-T properties.

- General suitability - Under common installation practices and chemical compatibility.
- Conditional suitability - Appropriate measures ensure maximum performance for joint design and gasket installation. Technical consultation is recommended.
- Limited suitability - Technical consultation is mandatory.

σ_{BO} diagram represents σ_{BO} values for 2 mm thickness. These values indicate the maximum in-service compressive pressures which can be applied on the gasket without risking destruction or damage to the gasket.

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