

A NEW GENERATION

High-end PTFE and manufacturing technology lead to diaphragms with long service life.

The market for diaphragms such as those used in pumps, valves, etc. is dominated by rubber-PTFE composites. Yet today nearly all composite parts can be replaced by homogenous PTFE diaphragms. This avoids previous disadvantages like separation, fiber cracks or crazing (frost-like internal cracks). Development costs are reduced significantly. Particularly in terms of reverse bending strength these diaphragms benefit from the new materials.



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Diaphragms are primarily used as hermetic seals for separation of media [fluids] in

moving systems. The fields of application are varied: pumps, compensators, valves, pressure transmitters, accumulators, drives, etc. Almost all the materials used for such applications are members of the elastomer family. To enable the absorption of higher media [fluid] pressures these materials are usually reinforced by fabric inserts. For use in the chemical, pharmaceutical and food industries, PTFE-laminated rubber diaphragms have been the standard material. Usually the sheet laminate is intended to provide protection from chemical influences, and often the fact that the fluoroplastic material is physiologically harmless is desirable as well. Yet the development of multi-layered diaphragms is costly and time-consuming since it requires special tools. In addition, the complexity of the manufacturing process may result in variances harboring the risk of premature component failure.

Conventional Design Is Problematic

The user is confronted with further weaknesses: when aggressive media [fluids] come into play the elastomer back may be attacked despite the PTFE laminate. This is due to the diffusion of substances through the usually thin sheet. Often the layers separate from each other as early as in normal operating conditions. The differences in the E- and G-modulus of the materials used leads to in-homogenous distributions of stress impacting adversely on the boundary layers. This peculiarity often reduces the service life of a composite diaphragm.

With laminated rubber diaphragms, PTFE is only used as a surface material. However, design engineers increasingly opt for the use of PTFE without rubber. Meanwhile this material supports the design of assembly components

which are at least equal to the mechanical properties of elastomer composites. Due to the use of cutting technology in the manufacturing process the designer has virtually unlimited options. In practically all cases extremely accurate customization to the existing assembly space – to replace a problematic composite diaphragm, for example – can be achieved. Medium-sized manufacturing volumes provided, even spare parts can be substituted in a cost-effective manner.

Broad Application Spectrum

If the seal manufacturer has in-house test rigs pressure, temperature, stroke and frequency can be modeled to test the service life of diaphragms. This allows the development of individual elements for myriad requirements within a short time frame. Depending on the particular application, various diameters and wall thickness – ranging from a few tenths to several millimeters – can be realized. Other functional features such as flange areas, O-ring grooves, threads, pressure plates, back rings or shafts may be integrated as well. Stud bolts or inserts are welded or threaded in.

Modified PTFE Achieves High Level of Reverse Bending Strength

One of polytetrafluoroethylene's desirable properties is its extreme resistance to frequent bending of its structure. This behavior has not been observed with any other thermoplastic material. It has already made PTFE the preferred material for diaphragms and bellows even before the advent of new generations of PTFE. HS 22121 now provides a PTFE type which surpasses all previous durability values. The values confirmed for this material exceed those of first-generation PTFE threefold, those of second-generation PTFE even tenfold. At the same time, the advantages of modified PTFE, including lower permeation, reduced cold flow and a surface that allows smooth cutting, are retained.

For applications in which extremely high durability is not necessary or other requirements are more critical, developers can choose from a broad offering of different grades of PTFE. In addition to FDA-conforming materials for the food industry and especially pure grades for the semiconductor industry, this manufacturer's portfolio also encompasses conductive material conforming to Atex 94/9/EC (European standard EN 13436). These materials can also be used to manufacture bellows.



The 2nd generation of homogenous PTFE diaphragms enables new designs and has a high level of reverse bending strength

For operators and design engineers

Laminated rubber-PTFE diaphragms harbor the risk of failure on account of diffusion processes, inhomogenous stress distribution and batch variances.

Due to the use of cutting technology in manufacturing, the 2nd generation of homogenous PTFE diaphragms enables new designs.

The new material has enormous permanent and reverse bending strength.

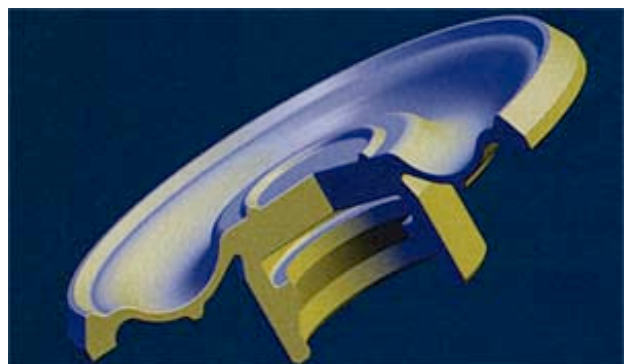
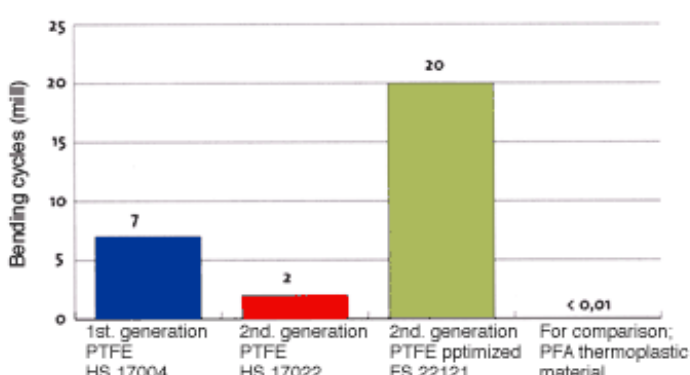


Figure 2: Cold flow under pressure load



Reverse bending test of various PTFE grades: To determine reverse bending strength a sheet of 1 mm thickness ("bone") standardized to SPI is bent by 900 with 4 Hertz in both directions. When complete breakage of the bent area has occurred the test rig stops.