DuPont Performance Elastomers Technical Feature based on the paper presented at the 2006 NTTC Cargo Tank Maintenance Seminar, Nashville by William Stahl.

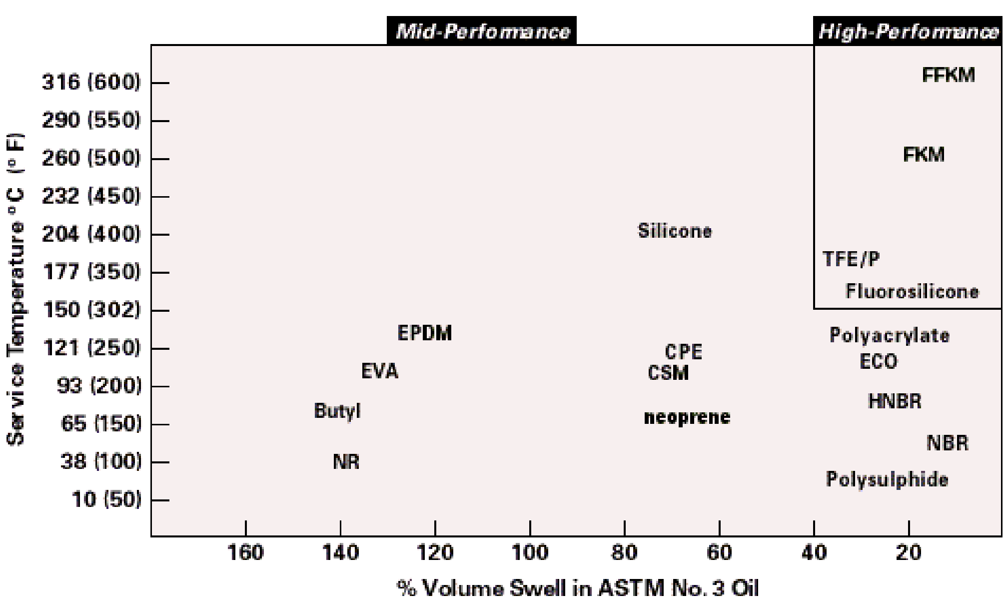
SEALS: CHOOSING THE RIGHT ELASTOMER FOR A GIVEN APPLICATION

To increase mean time between failure (MTBF), improve safety and reduce leaks, system and maintenance engineers must match a seal material's performance and cost to process conditions. William M. Stahl from DuPont Performance Elastomers (DPM) reviews the options available and suggests an easy evaluation process to help you make the right choice.

There are over 20 classes of natural and synthetic elastomers. They share common characteristics including elastic recovery after stress, flexibility, extrusion resistance and relative impermeability to gases and liquids, but each has its own unique properties that can be modified by other ingredients. Elastomers are usually formulated by compounders to present specific engineering properties for an application. With the wide choice of materials available, it is important for seal specifiers to consult with the seal manufacturer to determine the right elastomer for the application.

Relative Heat and Oil Resistance

SAE J200 (ASTM D2000) describes a classification system for specifying rubber products (see chart). It positions elastomers by resistance to heat aging and swelling in oil. To predict chemical and thermal resistance in hostile chemical process environments one must rely on field experience, laboratory testing and guidance from material experts.

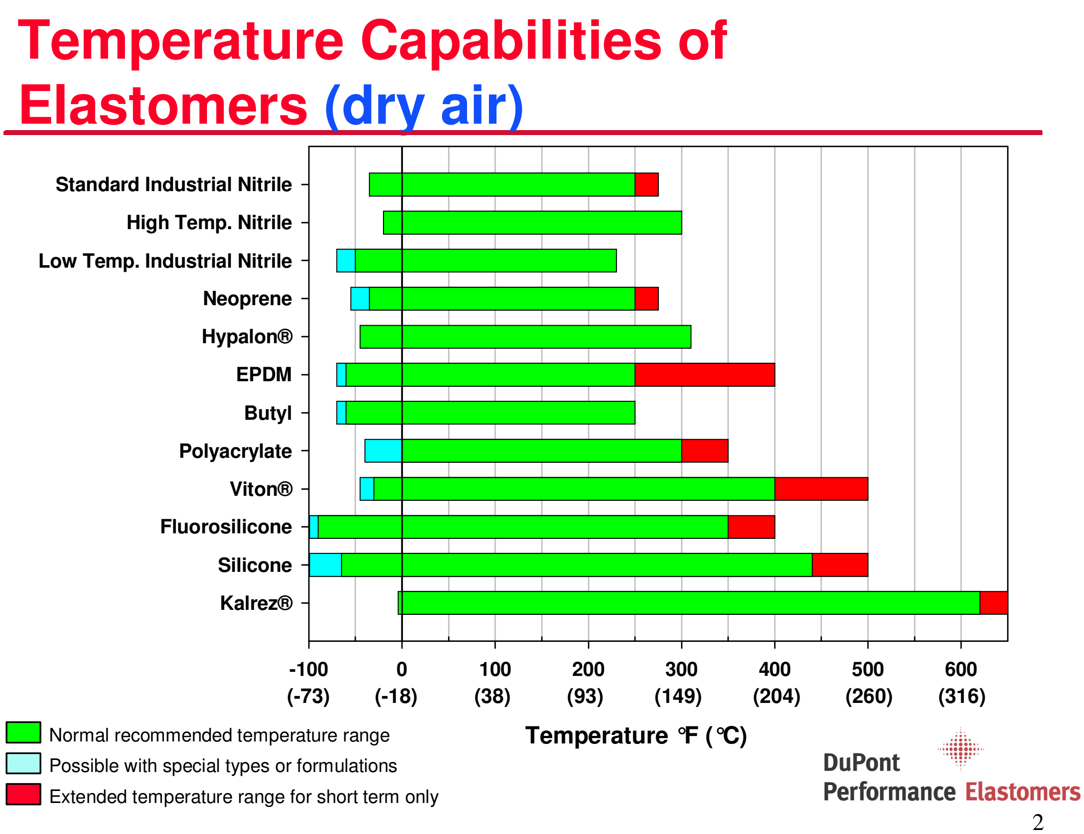


Chemical compatibility

Elastomers are rated for compatibility with various media including fluids, weather and ozone. In a fluid environment elastomers may swell, react chemically with the fluid causing changes in the polymer structure, or solubles may be extracted causing a decrease in volume. Generally, below 5 to 10 percent swell is considered excellent. Although swelling is a key criterion for assessing part compatibility, other properties should be measured as well:

Thermal Properties

The mechanical properties of an elastomer will generally change after prolonged exposure to high temperatures. Natural rubber, for example, will become gummy whereas polychloroprene slowly hardens. Relatively small changes in temperature may cause large differences in the degree of deterioration. Heat aging tests are usually based on 70-hour exposure in thermally controlled hot air. In critical applications, engineers should consult with the part manufacturers to see if long-term exposure in a particular medium has been evaluated. In addition, tests should be performed under conditions that closely mirror the actual process conditions.



Mechanical Properties

Mechanical properties that influence elastomer performance include ***compression set, tensile strength, elongation, hardness*** and ***abrasion resistance***. Most can be modified through the compounding process to impart the required characteristics.

Other Properties

Other properties to consider in specific applications include:

Weathering - Cracking, peeling, chalking, color changes and other surface defects that may lead to failure can occur when elastomers are exposed to weather and ozone. Synthetic elastomers are inherently more resistant than natural rubber.

Permeability - Permeability is a measure of the ease with which a liquid, vapor, or gas can pass through an elastomer, and is important in many applications, including gaskets, seals and diaphragms.

How to Select Elastomer Seals

The following important selection criteria should be considered:

S*ervice conditions* including:

- Fluid to be sealed, including any contaminants or additives.
- Minimum and maximum temperature range, thermal cycling and potential excursions.
- Minimum and maximum pressure range, and compression/decompression rate.
- Vacuum application, and whether cyclic.
- Motion, either static or dynamic.

Critical/ ***design requirements***, including:

- Component geometry/description, e.g. O-ring, gasket, diaphragm, etc.
- The effect of chemical media on the seal.
- Desired service life.
- Assembly, including lubricants, installed stretch, etc.
- Critical dimensions and tolerances.

Important ***inspection requirement,*** including:

- Defining inspection criteria.
- Determining the need for lot sampling.
- Setting acceptable quality levels (AQLs).
- Indicating the critical sealing surface.

Material specification and traceability:

- Define material specifications by ASTM, SAE, military specification or other recognized standard.
- Discuss sealing material specification and certification with your seal supplier.
- Ask supplier if compound changes may occur without customer knowledge and how to protect against it.

Cost versus Value

When selecting sealing materials, seal life and maintenance costs must be included. The guiding principle should be *"value-in-use"*. Specifying the appropriate seal can also prevent costly unscheduled downtime and dangerous leakage, as the sum of the costs related to the quality and durability of the installed seal usually far outweigh its purchase price.

New Developments in Elastomers

The regulatory demands on the industry are driving manufacturers towards cost-efficient environmental solutions. A European directive regarding Integrated Pollution Prevention and Control will be introduced in October 2007, and process plants will be compelled to reduce the loss of volatile organic compounds through unexpected leaks, evaporation, flaring, or spills (IPPC, 96/61/EU).

In response to the increasing requirements of pump manufacturers and other customers, DuPont Performance Elastomers (DPE) is continually improving its product line and developing new elastomeric materials to offer a sealing product for virtually every critical chemical process:

Improved specialty fluoroelastomers

Viton® fluoroelastomers are used worldwide to make parts and seals for applications in the chemical, pharmaceutical, and food processing, as well as in the automotive industry. The latest products are FDA approved Viton® GF-600S and Viton® Extreme™ ETP-600S which provide superior steam resistance compared to silicone, better caustic cleaning fluid resistance compared to EPDM and bisphenol-cured fluoroelastomer (FKM), and low total organic carbon and metal extractables similar to PTFE (polytetrafluoroethylene). Both products are made with Advanced Polymer Architecture (APA), a proprietary development by the company that improves the processing performance of specialty fluoroelastomers.

Perfluoroelastomer —the ultimate

The traditional approach to cost-cutting suggests that for customers under extreme pressure to gain efficiencies, opting for premium technology is counter-intuitive. But DPE and its customers have been able to document the long-term value of Kalrez® perfluoroelastomer parts.

Perfluoroelastomer (FFKM) is the ultimate level for elastomeric sealing. DPE markets Kalrez® Spectrum™ 6375 and Kalrez® Spectrum™ 7075 perfluoroelastomer parts for the most aggressive chemical process environments. Kalrez® Spectrum™ 6375 enables users to standardize around one instead of two or three sealing compounds in inventory by providing outstanding performance in acids, bases, amines and steam up to 275°C service temperature. Kalrez® Spectrum™ 7075 provides extended seal life, sealing force retention and thermal resistance up to 327°C.

Online Chemical Resistance Guide

DPE's "Chemical Resistance Guide" helps you choose the best elastomer for given application conditions. It is available online free-of-charge at www.dupontelastomers.com, and rates the performance of 20 elastomers in over 1,000 chemicals at room temperature.

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Web: www.dupontelastomers.com