Viton® fluoroelastomer

From DuPont Performance Elastomers

Viton® made with APA Provides FDA Compliance and More

Improved Steam and Fluids Resistance Key in Food and Pharmaceutical Applications

Bisphenol-cured types of Viton® or "steam-resistant fluoroelastomers" provide significant improvements in steam resistance, compared to the older, diamine-cured types of fluoroelastomers (FKM). Viton® A-401C, a bisphenol -cured type of Viton®, quickly became the standard in steam-resistant pharmaceutical fluoroelastomer sealing applications when it was shown in 1996 to be compliant with FDA food contact regulation 21 CFR 177.2600, Rubber Goods Intended for Repeated Use. Despite its improved steam resistance, bisphenol-cured Viton® exhibited inadequate service in some sterilization processes, particularly those that involved the use of highly caustic chemicals.

As an alternative to steam-resistant fluoroelastomers, pharmaceutical and food manufacturers often use EPDM or silicone in cleaning applications that use caustics and steam. EPDM, while it is capable of providing excellent steam resistance, exhibits relatively poor resistance to some commonly used cleaning fluids. Silicone, on the other hand, may provide good resistance to a wide variety of cleaning fluids but poor steam resistance. The combination of excellent steam resistance and fluids resistance has been demonstrated with the most recent Viton® specialty polymers.

Based on laboratory results, the latest development in Viton® fluoroelastomer technology, Advanced Polymer Architecture (APA), provides improved resistance to steam and some cleaning fluids used in food and pharmaceutical processes when compared to diamine- or bisphenol-cured dipolymer fluoroelastomers. Compared to EPDM and silicone, Viton® made with APA provides an attractive combination of the following:

- Resistance to a wide variety of food- and pharmaceutical-related cleaning fluids, including fluids that are highly caustic in nature
- Resistance to steam

As with any material, evaluation of any compound under end-use conditions prior to specification is essential.

Viton® made with APA Provides a New Level of Performance

Viton® made with APA is a proprietary development by DuPont Performance Elastomers that improves the performance of specialty fluoroelastomers. The following section offers a brief description of Viton® polymers that provide FDA compliance and their unique capabilities.

- **Viton® GF-600S** is a high-fluorine, peroxide-cure type of Viton®. Compared to bisphenol-cured dipolymer FKM, such as Viton® A-401C, vulcanizates based on Viton® GF-600S exhibit excellent steam resistance and superior resistance to a much wider variety of cleaning fluids. Vulcanizates based on Viton® GF-600S exhibit excellent physical properties, including resistance to compression set.
- **Viton® ETP-600S** is a very unique copolymer that exhibits excellent steam resistance and resistance to attack by an exceptionally broad variety of chemicals and fluids, including aliphatic and aromatic hydrocarbons, acids, bases, all types of alcohols and even low molecular weight ketones, esters, and aldehydes.

Viton® made with APA Provides Improved Steam Resistance

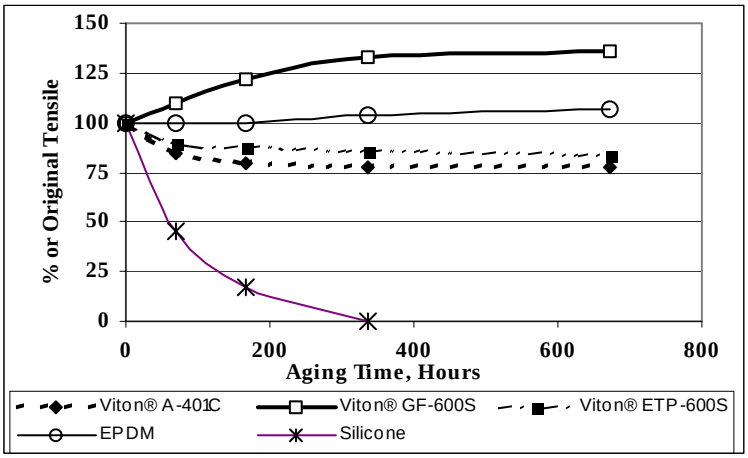
As mentioned earlier, bisphenol-cured Viton® has been the standard for applications where steam resistance is critical. As shown in Figure 1, APA polymers provide even better resistance to property loss in steam.

As these test results demonstrate, Viton® polymers based on APA technology, show excellent retention of tensile properties in steam aging, whereas the strength of the vulcanizate made with silicone drops off to essentially zero in less than 400 hours.

Figure 1

Viton® made with APA vs Viton® A-401C and Other Elastomers

% of Original Tensile Strength* in 80 psi Steam (156°C) After 672 Hours



**ASTM Test Method D471*

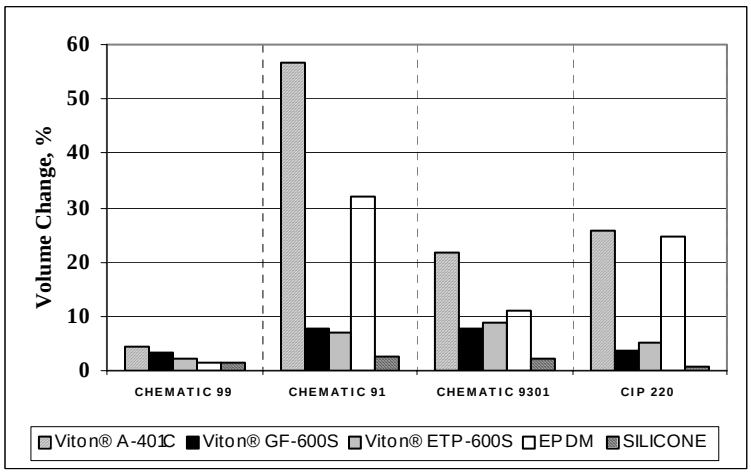
Viton® made with APA Demonstrates Excellent Fluids Resistance

In addition to maintaining its tensile properties in steam, APA polymers also demonstrate improved resistance to volume change in cleaning fluids, such as Chematic® 91, Chematic® 9301, and CIP 220® compared to bisphenol-cure dipolymer FKM, and EPDM (Figure 2).

Figure 2

Viton® made with APA vs Viton® 401C and Other Elastomers

% Volume Change* in Various Cleaning Fluids After 1008 Hours @ 70° C



**ASTM Test Method D471*

As indicated in Figure 2, vulcanizates based on Viton® GF-600S and Viton® ETP-600S exhibit lower volume swell in a wider variety of cleaning fluids than any of the other polymers tested except silicone. The combination of steam resistance and resistance to a wide variety of cleaning solutions make the APA polymers attractive candidates for food and pharmaceutical sealing applications compared to silicone and EPDM.

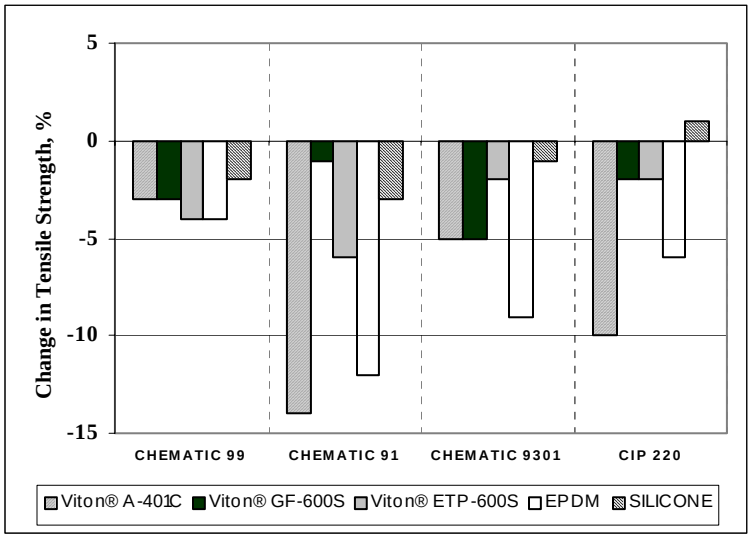
Volume change in fluids is an indication of the ability of a vulcanizate to maintain sealing performance in a given fluid. If a vulcanizate exhibits excessive swelling, it also tends to exhibit significant losses in hardness and strength which may result in a reduction in the ability of a gasket or O-ring made from the vulcanizate to maintain a seal under pressure.

Figure 3 shows that, after aging in various commercial cleaning fluids, compounds based on Viton® GF-600S and Viton® ETP-600S show virtually no change in tensile strength, whereas EPDM demonstrates a larger loss in tensile strength after the 1008 hour aging period in Chematic 91 and CIP 220.

Figure 3

Viton® made with APA vs Viton® 401C and Other Elastomers

Change in Tensile Strength* in Various Cleaning Fluids After 1008 Hours @ 70° C



**ASTM Test Method D471*

Summary

Sterilization processes used by food and pharmaceutical manufacturers frequently use steam, caustic chemicals or a combination of both. These aggressive conditions are demanding on sealing materials that are often used in these environments, such as EPDM, silicone or fluoroelastomers. EPDM, while it is capable of providing excellent steam resistance, exhibits relatively poor resistance to some commonly used cleaning fluids. Silicone may provide good resistance to a wide variety of cleaning fluids but poor steam resistance. The most recent Viton® specialty polymers made from APA provide an excellent combination of steam resistance and resistance to cleaning fluids encountered in pharmaceutical and food processes.

Based on laboratory results Viton® specialty polymers made with APA, especially GF-600S and ETP-600S provide:

- Improved steam and caustic cleaning fluid resistance vs bisphenol- or diamine-cured FKM
- Improved steam resistance compared to silicone
- Improved caustic cleaning fluid resistance vs EPDM.

The balance of steam and fluid resistance makes APA polymers attractive candidates for sealing in food and pharmaceutical processes in comparison to other alternatives.

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