Technical Information

Introduction
Viton™ A-HV is a high viscosity fluoroelastomer dipolymer that provides vulcanizates with high tensile strength and best resistance to compression set compared to other Bisphenol AF curable types.

Features
- Bisphenol AF and Diamine Curable
- High Tensile Strength
- Low Compression Set

Typical applications include compression molded seals, O-rings, gaskets, and oil-field parts, such as packers.

Product Description

<table>
<thead>
<tr>
<th>Chemical Composition</th>
<th>Dipolymer of hexafluoropropylene, vinylidene fluoride</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Form</td>
<td>Sheet</td>
</tr>
<tr>
<td>Appearance</td>
<td>White to tan</td>
</tr>
<tr>
<td>Odor</td>
<td>Negligible</td>
</tr>
<tr>
<td>Mooney Viscosity, ML 1 + 10 at 149 °C (300 °F)</td>
<td>100</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>1.82</td>
</tr>
<tr>
<td>Storage Stability</td>
<td>Excellent</td>
</tr>
<tr>
<td>Fluorine, %</td>
<td>~66</td>
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</table>

Curing Systems for Viton™ A-Types

The A-types of Viton™ can be cured with Viton™ Curative Masterbatches (No. 20 and 30), Curative No. 50, or with diamines—Viton™ Curative Nos. 1 (VC-1) or 3 (VC-3). Typical formulations and physical properties for compounds using Curatives No. 20, No. 30, and No. 50 are found in Table 1. A comparison of A-HV to A-500 and A-700 can be found in Table 2. For additional information on curing Viton™, see technical bulletin “Viton™ Curatives No. 20, No. 30, and No. 50.”

Processing

Mixing

Perhaps the most important aspect of mixing Viton™ is to use equipment free of contamination from other polymer mixes. Residual oils and sulfur or sulfur-containing chemicals can have ruinous effects on mixing and curing characteristics of Viton™ compounds. Viton™ compounds should be mixed on a mill or in an internal mixer that has adequate cooling capacity; not only to prevent stock scorch, but also to prevent sticking of the mix to rolls or rotors. All powdered ingredients should be premixed—this ensures good dispersion and prevents sticking, which occurs if magnesia is added by itself early in the mix. The use of Viton™ Curative No. 1 (VC-1) results in fairly scorchy compounds. For this reason, VC-1 should be added last when mill mixing and on the drop mill when using an internal mixer.

Depending on the acid acceptor and filler systems used, re-milling compounded stock after a minimum of 24 hr often improves physical properties of vulcanizates.

Extruding

High viscosity A-types like A-HV typically provide a better extrudate surface when processed through a hot die—100–140 °C (212–284 °F). The use of 1–1.5 phr of a process aid, such as VPA No. 2 or carnauba wax, markedly improves the surface and definition of extrudates. When using a process aid, it is best to keep the feed zone cool relative to the die and head areas of the extruder to avoid stock slippage and loss of feed.

Curing

Compounds may be cured at temperatures as low as 160 °C (320 °F), but, when using Curative Masterbatches, 170 °C (338 °F) is a minimum temperature to use if practical cure times are desired. These are guidelines for a simple, compression-molded part; in transfer molding or compression molding, where the stock flows significantly, enough shear heat may
result to shorten "expected" cure times significantly. To attain maximum physical properties, cured parts of Viton™ must also be oven post-cured for 24 hr at a temperature between 200–260 °C (392–500 °F). In general, property values will reach 80–90% of maximum in 12 hr at 232 °C (450 °F). Parts thicker than 6 mm (0.25 in) should be step post-cured to avoid internal fissuring. Starting at 125 °C (257 °F), the heat can then be increased hourly to the final desired post-cure temperature. For more information, see technical bulletin "Viton™ Fluoroelastomers—Oven Post-Curing of Parts."

**Safety and Handling**

Before handling or processing Viton™ A-HV, read and be guided by the suggestions in the technical bulletin, “Handling Precautions for Viton™ and Related Chemicals.”

Table 1. Viton™ A-HV Compared to E-45

<table>
<thead>
<tr>
<th>Compound #</th>
<th>CSG0244-10</th>
<th>CSG0244-11</th>
<th>CSG0244-06</th>
<th>CSG0244-07</th>
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<tr>
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<td>94.2</td>
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<td>Viton™ E-45</td>
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<td>94.2</td>
<td>97.5</td>
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<tr>
<td>N-990</td>
<td>30</td>
<td>30</td>
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<tr>
<td>Calcium Hydroxide</td>
<td>6</td>
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<td>Magnesium Oxide</td>
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Compound Mooney Viscosity, ML1+10, 121 °C (250 °F)

<table>
<thead>
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<tr>
<td>ML1+10 (MU)</td>
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<td>ML10 (MU)</td>
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Mooney Scorch, Small Rotor, 121 °C (250 °F), 30 min Test

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<tr>
<td>ML (MU)</td>
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<tr>
<td>T2 (min)</td>
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<td>T5 (min)</td>
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MDR at 177 °C (351 °F), 10 min, 0.5° Arc

<table>
<thead>
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<th>MDR at 177 °C (351 °F), 10 min, 0.5° Arc</th>
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<tr>
<td>ML (dNm)</td>
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<tr>
<td>MH (dNm)</td>
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<tr>
<td>ts2 (min)</td>
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<tr>
<td>T50 (min)</td>
</tr>
<tr>
<td>T90 (min)</td>
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<td>T95 (min)</td>
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Vulcanizate Properties

<table>
<thead>
<tr>
<th>Press-Cured 10 min at 177 °C (351 °F), Oven Post-Cured 24 hr at 232 °C (418 °F)</th>
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<tbody>
<tr>
<td>Original Properties at 23 °C (73 °F)—No Post-Cure</td>
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<tr>
<td>Hardness (Shore A)</td>
</tr>
<tr>
<td>10% Modulus (MPa)</td>
</tr>
<tr>
<td>25% Modulus (MPa)</td>
</tr>
<tr>
<td>50% Modulus (MPa)</td>
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<tr>
<td>100% Modulus (MPa)</td>
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<tr>
<td>Tensile at Break (MPa)</td>
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<tr>
<td>Elongation at Break (%)</td>
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<tr>
<td>Die B Tear (kN/m)</td>
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<tr>
<td>Die C Tear (kN/m)</td>
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continued
Table 1. Viton™ A-HV Compared to E-45 (continued)

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<th>Compound #</th>
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<th>CSG0244-06</th>
<th>CSG0244-07</th>
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<td>Hardness (Shore A)</td>
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<td>10% Modulus (MPa)</td>
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<td>50% Modulus (MPa)</td>
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<td>100% Modulus (MPa)</td>
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<td>8.44</td>
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<td>Elongation at Break (%)</td>
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<td>183</td>
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<td>Die B Tear (kN/m)</td>
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<td>Die C Tear (kN/m)</td>
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<td>20.0</td>
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<td><strong>Hot Air Aged 72 hr at 275 °C (527 °F)</strong></td>
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<td>Hardness (Shore A)</td>
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<td>Hardness (Pt. Change)</td>
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<td>100% Modulus (MPa)</td>
<td>5.5</td>
<td>5.7</td>
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<tr>
<td>100% Modulus (% Change)</td>
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<td>-33</td>
<td>-36</td>
<td>-28</td>
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<td>Tensile at Break (MPa)</td>
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<td>11.8</td>
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<tr>
<td>Tensile at Break (% Change)</td>
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<td>-27</td>
<td>-4</td>
<td>-26</td>
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<tr>
<td>Elongation at Break (%)</td>
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<td>216</td>
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<td>229</td>
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<td>Elongation at Break (% Change)</td>
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<td>23</td>
<td>60</td>
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<td><strong>Hot Air Aged 168 hr at 275 °C (527 °F)</strong></td>
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<td>Hardness (Shore A)</td>
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<td>Hardness (Pt. Change)</td>
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<td>4</td>
<td>5</td>
<td>7</td>
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<td>100% Modulus (MPa)</td>
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<td>5.3</td>
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<tr>
<td>100% Modulus (% Change)</td>
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<td>-37</td>
<td>-31</td>
<td>-25</td>
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<tr>
<td>Tensile at Break (MPa)</td>
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<td>8.2</td>
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<td>7.8</td>
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<tr>
<td>Tensile at Break (% Change)</td>
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<td>-49</td>
<td>-30</td>
<td>-45</td>
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<td>Elongation at Break (%)</td>
<td>216</td>
<td>189</td>
<td>192</td>
<td>178</td>
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<td>Elongation at Break (% Change)</td>
<td>16</td>
<td>8</td>
<td>27</td>
<td>-2</td>
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<tr>
<td><strong>Hot Air Aged 504 hr at 250 °C (482 °F)</strong></td>
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<tr>
<td>Hardness (Shore A)</td>
<td>79</td>
<td>80</td>
<td>84</td>
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<tr>
<td>Hardness (Pt. Change)</td>
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<td>5</td>
<td>6</td>
<td>7</td>
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<tr>
<td>100% Modulus (MPa)</td>
<td>5.9</td>
<td>6.5</td>
<td>5.2</td>
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<td>100% Modulus (% Change)</td>
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<td>-24</td>
<td>-24</td>
<td>-16</td>
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<td>Tensile at Break (MPa)</td>
<td>11.1</td>
<td>10.6</td>
<td>9.9</td>
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<tr>
<td>Tensile at Break (% Change)</td>
<td>-33</td>
<td>-34</td>
<td>-11</td>
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<tr>
<td>Elongation at Break (%)</td>
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<td>190</td>
<td>209</td>
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<tr>
<td>Elongation at Break (% Change)</td>
<td>6</td>
<td>9</td>
<td>37</td>
<td>9</td>
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<td><strong>Compression Set, Pellet, Method B, No Post-Cure</strong></td>
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<tr>
<td>70 hr at 150 °C (302 °F) (%)</td>
<td>46</td>
<td>53</td>
<td>56</td>
<td>65</td>
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<tr>
<td>70 hr at 200 °C (392 °F) (%)</td>
<td>64</td>
<td>71</td>
<td>72</td>
<td>80</td>
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<tr>
<td><strong>Compression Set, Pellet, Method B, Post-Cured</strong></td>
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<tr>
<td>70 hr at 200 °C (392 °F) (%)</td>
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<td>16</td>
<td>18</td>
<td>19</td>
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<tr>
<td>70 hr at 230 °C (446 °F) (%)</td>
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<td>34</td>
<td>40</td>
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## Table 2. Viton™ A-HV Compared to A-700 and A-500

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<th>A-HV</th>
<th>A-700</th>
<th>A-500</th>
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<tbody>
<tr>
<td>Viton™ A-HV</td>
<td>97.5</td>
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<tr>
<td>Viton™ A-700</td>
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<td>97.5</td>
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<td>Viton™ A-500</td>
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<td>97.5</td>
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<tr>
<td>MT Black (N-990)</td>
<td>30</td>
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<tr>
<td>Maglite® D</td>
<td>3</td>
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<tr>
<td>Calcium Hydroxide</td>
<td>6</td>
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<tr>
<td>Viton™ Curative No. 50</td>
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<th><strong>Mooney Scorch, MS at 121 °C (250 °F)</strong></th>
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<tr>
<td>Minimum Viscosity, units</td>
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<td>64</td>
<td>48</td>
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<tr>
<td>Time to 1 pt rise, min</td>
<td>16</td>
<td>13</td>
<td>12</td>
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<tr>
<td>Time to 2 pt rise, min</td>
<td>26</td>
<td>—</td>
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<td>Time to 5 pt rise, min</td>
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<td>Time to 10 pt rise, min</td>
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<td>Pts rise to 30 min</td>
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<th><strong>MDR at 177 °C (351 °F), 0.5° Arc, 6 min Motor</strong></th>
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<tbody>
<tr>
<td>Minimum Viscosity, ML, N·m</td>
<td>0.6</td>
<td>0.3</td>
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<td>Scorch Time, ts2, min</td>
<td>0.7</td>
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<td>0.9</td>
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<td>Maximum Torque, MH, N·m</td>
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<td>50% Cure, M50, N·m</td>
<td>2.2</td>
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<td>1.6</td>
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<tr>
<td>Time to 50% Cure, t'50, min</td>
<td>1.4</td>
<td>1.3</td>
<td>1.3</td>
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<tr>
<td>90% Cure, M90, N·m</td>
<td>3.5</td>
<td>2.9</td>
<td>2.8</td>
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<td>Time to 90% Cure, t'90, min</td>
<td>2.2</td>
<td>1.9</td>
<td>2</td>
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<table>
<thead>
<tr>
<th><strong>Slabs Cured 10 min at 177 °C (351 °F) and Post-Cured 24 hr at 232 °C (450 °F)</strong></th>
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<tr>
<td>Stress/Strain—Original at 23 °C (73 °F)</td>
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<tr>
<td>100% Modulus, MPa</td>
<td>7.7</td>
<td>6.6</td>
<td>6.4</td>
</tr>
<tr>
<td>Tensile Strength at Break, MPa</td>
<td>15.8</td>
<td>13.6</td>
<td>13.9</td>
</tr>
<tr>
<td>Elongation at Break, %</td>
<td>195</td>
<td>210</td>
<td>220</td>
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<tr>
<td>Hardness, Durometer A</td>
<td>72</td>
<td>73</td>
<td>73</td>
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<table>
<thead>
<tr>
<th><strong>Stress/Strain at 23 °C (73 °F)—After Aging 70 hr at 200 °C (392 °F)</strong></th>
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<tr>
<td>100% Modulus, MPa</td>
<td>8.1</td>
<td>7.3</td>
<td>6.8</td>
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<tr>
<td>Tensile Strength at Break, MPa</td>
<td>15.4</td>
<td>15.2</td>
<td>14.9</td>
</tr>
<tr>
<td>Elongation at Break, %</td>
<td>185</td>
<td>200</td>
<td>220</td>
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<tr>
<td>Hardness, Durometer A</td>
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<th><strong>Stress/Strain at 23 °C (73 °F)—After Aging 168 hr at 200 °C (392 °F)</strong></th>
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<td>Tensile Strength at Break, MPa</td>
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<tr>
<td>Elongation at Break, %</td>
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<td>Hardness, Durometer A</td>
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continued
Table 2. Viton™ A-HV Compared to A-700 and A-500 (continued)

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<th>A-HV</th>
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<th>A-500</th>
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<tbody>
<tr>
<td><strong>Stress/Strain at 23 °C (73 °F)—After Aging 70 hr at 250 °C (482 °F)</strong></td>
<td></td>
<td></td>
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<td>Tensile Strength at Break, MPa</td>
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<td>Elongation at Break, %</td>
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<td>Hardness, Durometer A</td>
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<tr>
<td><strong>Stress/Strain at 23 °C (73 °F)—After Aging 168 hr at 250 °C (482 °F)</strong></td>
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<td>100% Modulus, MPa</td>
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<td>Tensile Strength at Break, MPa</td>
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<td>Elongation at Break, %</td>
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<td>Hardness, Durometer A</td>
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<tr>
<td><strong>Stress/Strain at 23 °C (73 °F)—After Aging 70 hr at 200 °C (392 °F) in IRM-902 Oil</strong></td>
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<td>% Change in Volume</td>
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<td><strong>Stress/Strain at 23 °C (73 °F)—After Aging 168 hr at 23 °C (73 °F) in 85% Reg. Fuel °C/15% Methanol</strong></td>
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<td><strong>Compression Set, Method B, O-Rings, %</strong></td>
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<td>70 hr at 150 °C (302 °F)</td>
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<td>70 hr at 200 °C (392 °F)</td>
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<td>168 hr at 200 °C (392 °F)</td>
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<td>22 hr at 232 °C (450 °F)</td>
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<td><strong>Temperature Retraction</strong></td>
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<td>TR-10, °C (°F)</td>
<td>−14(6.8)</td>
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**Test Procedures**

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<tr>
<th>Property Measured</th>
<th>Test Procedure</th>
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<tr>
<td>Compression Set</td>
<td>ASTM D395, Method B (25% deflection)</td>
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<td>Compression Set, O-Rings</td>
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<td>Hardness</td>
<td>ASTM D2240-91, durometer A</td>
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<td>MDR (moving die rheometer)</td>
<td>ASTM D5289</td>
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<td>Mooney Scorch</td>
<td>ASTM D1646, small rotor at 121 °C (250 °F)</td>
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<tr>
<td>Mooney Viscosity</td>
<td>ASTM D1646, large rotor at 121 °C (250 °F)</td>
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<td>Property Change After Heat Aging</td>
<td>ASTM D573</td>
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<td>Stress/Strain Properties</td>
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<td>ASTM D412, pulled at 8.5 mm/sec (20 in/min)</td>
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<td>Tear Die B and Tear Die C</td>
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<td>Volume Change in Fluids</td>
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Note: Test temperature is 23 °C (73 °F), except where specified otherwise.

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