High Expansion Coefficient Glasses Can be Sealed to Common Metals

A new series of high expansion coefficient glasses can be sealed by fusion onto the hot surface of metals and alloys. Glass-to-metal seals are used extensively in the electronic and electrical industries. The kinds of metals involved vary from the low expansion coefficient alloys such as kovar (iron-nickel-cobalt), cold rolled steels and nickel, to the high expansion coefficient metals such as copper, stainless steel, and aluminum.

The glasses developed have relatively low working temperatures and good chemical durability, and can be used in electrical insulators and feedthroughs to fluid or vacuum systems. Other applications include oxidation resistant or protective coatings on certain metal alloys for high temperature applications. Some representative samples of these glasses and certain selected properties appear in Table 1.

Notes:
1. The following documentation may be obtained from:
   - National Technical Information Service
   - Springfield, Virginia 22151
   - Single document price $3.00
   - (or microfiche $0.60)

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>SiO₂</th>
<th>Na₂O</th>
<th>Al₂O₃</th>
<th>K₂O</th>
<th>MgO</th>
<th>CaO</th>
<th>TiO₂</th>
<th>BaO</th>
<th>NaF</th>
<th>Sag Point °C</th>
<th>Expansion Coefficient x 10⁶ (inch/inch/°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>53</td>
<td>39.6</td>
<td>11.6</td>
<td>18.4</td>
<td>---</td>
<td>---</td>
<td>18.4</td>
<td>6.9</td>
<td>---</td>
<td>5.1</td>
<td>593</td>
<td>11.1</td>
</tr>
<tr>
<td>54</td>
<td>37.3</td>
<td>11.8</td>
<td>22.4</td>
<td>---</td>
<td>---</td>
<td>14.0</td>
<td>4.7</td>
<td>4.7</td>
<td>5.1</td>
<td>602</td>
<td>9.4</td>
</tr>
<tr>
<td>6</td>
<td>64.8</td>
<td>9.6</td>
<td>9.4</td>
<td>13.1</td>
<td>3.1</td>
<td>----</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>530</td>
<td>13.1</td>
</tr>
</tbody>
</table>

Notes:
1. Sag Point is the temperature at which glass begins to soften or flow.
2. An example of an application for the sample 6 composition is to seal the ends of a conventional electrical heating element where the high-expansion coefficient and good electrical and chemical properties of this glass are a distinct advantage.

Reference:
- NASA-CR-72520 (N70-14570), Development and Evaluation of Controlled Viscosity Coatings for Superalloys
- NASA CR 81007 (N70-14570), Development and Evaluation of Controlled Viscosity Coatings for Superalloys

2. Technical questions may be directed to:
   - Technology Utilization Officer
   - Lewis Research Center
   - 21000 Brookpark Road
   - Cleveland, Ohio 44135
   - Reference: B70-10429

(continued overleaf)

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Patent status:
No patent action is contemplated by NASA.
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