Better PVC roofing membranes begin at the molecular level

DuPont™ Elvaloy® ketone ethylene ester (KEE) roofing resins lock in membrane flexibility. Premium-performance commercial roofing made with DuPont’s endurance-proven solids-phase flexibilizer delivers the ease and reliability of heat-welded seams, along with long-lasting toughness, weatherability and resistance to chemical attack.
Improved roofing membrane performance begins at the molecular level

When PVC roofing membranes were first developed, they were made flexible by adding oils or liquid plasticizers to the PVC compound. The problem with this approach was that hot weather caused the plasticizers to migrate to the membrane surface where they were permanently lost. With each such heating cycle, the membrane would become more brittle, eventually causing it to crack (typically in winter), as it expanded and contracted with the temperature cycling.

To address the problem, DuPont scientists developed a process that eliminated the need for liquid plasticizers. They found that PVC membrane flexibility and impact resistance could be “locked in” by changing to a solid, flexible high-molecular weight interpolymer during membrane manufacturing. Today, the roofing industry knows this material as DuPont™ Elvaloy® KEE. It’s a unique ethylene terpolymer tailored to specific performance needs during polymerization. The resin grades most often used in roofing membranes are profiled in Table 1. As the data indicate, these are soft, flexible polymers with elastomer-like properties and convenient melting points for thermoplastic processing.

Suppleness and strength to extend membrane life

When extruded or calendered into a sheet, a compound with DuPont™ Elvaloy® KEE is both flexible and exceptionally tough. (The terpolymer manufacturing technology is closely related to that used by DuPont to make Surlyn®, the tough cover material found on many of the world’s finest golf balls). Elvaloy® KEE is also highly resistant to chemicals, which can be important for roofing exposed to vent exhausts, air pollutants or acid rain. This inherent toughness, chemical resistance and flexibility combine to help roofing membranes last longer.

Because Elvaloy® KEE is both solid and flexible, there are no liquid plasticizers to migrate out during hot weather, so the membrane retains its flexibility even in the hottest regions, where roofing membranes are put to the test. And since the flexibility is permanent, membranes based on Elvaloy® KEE offer the advantage of easy workability in cold temperatures, an important consideration for many contractors. Elvaloy® KEE has been so effective in roofing applications, that engineers have developed and recognize an ASTM test standard (D-6754) to assure membranes contain KEE … a standard that literally redefines expectations for roofing membrane performance.
PROVEN PERFORMANCE IN SINGLE-PLY ROOFING MEMBRANES

Easier installations, seaming and repairs
Elvaloy® KEE alone will melt at 140°F (60°C), a temperature too low for most stand-alone plastics applications. However, this characteristic offers an advantage when Elvaloy® KEE is combined with another plastic such as PVC: it facilitates the thermoplastic welding process. When a membrane based on Elvaloy® KEE is welded, the seam becomes a monolithic layer that is absolutely weather-tight. The material fuses to itself in a totally integrated bond that won’t come apart.

Experienced contractors recognize the importance of skilled crews, efficient installations and reliable product performance to keep profitability high. Installing membranes based on Elvaloy® KEE goes faster due to the easier seaming, and there are fewer costly site revisits needed to correct problems.

Inseparable membrane components
Elvaloy® KEE has a natural ability to melt and bind with many different polymers and secondary materials. This is important to roofing membrane manufacturers as they consider how all ingredients in the compound will interact, whether a UV stabilizer, whitening agent, or biocide. With Elvaloy® KEE as the “flexibilizer” and binding agent, the manufacturer is better assured that all the ingredients will work in harmony, without separation or breakdown. The roofing membrane’s long-term performance is “locked in.”

Energy-efficient white roofing
Energy issues are growing in importance in the selection of all building materials, and roofing is no exception. Factoring in overall energy performance as part of system’s life-cycle cost, many customers and contractors are insisting on “white” as the color of choice in roofing.

The exceptional light and heat reflective properties of a white membrane can reduce a building’s internal cooling costs dramatically. In urban areas, white roofing can also help mitigate the “heat island” effect, helping reduce outdoor ambient temperatures. Urban heat islands are often 6 to 8 degrees hotter than nearby rural areas due to the concentration of black rooftops, paved surfaces and dark masonry surfaces. Light-reflective roofing based on Elvaloy® KEE can be part of a community’s effort to reduce ambient heat buildup.

Table 1. Typical physical properties for roofing grades of DuPont™ Elvaloy® KEE

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>TEST METHOD</th>
<th>TYPICAL REPORTED VALUE (a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Molecular weight</td>
<td>See note (b)</td>
<td>ELVALOY® 741</td>
</tr>
<tr>
<td>Density (g/cm3)</td>
<td>ASTM D792</td>
<td>&gt;300,000</td>
</tr>
<tr>
<td>Tensile strength, MPa (psi)</td>
<td>ASTM D1708</td>
<td>6.60 (957)</td>
</tr>
<tr>
<td>Elongation at break, %</td>
<td>ASTM D1708</td>
<td>415</td>
</tr>
<tr>
<td>Hardness, Shore A</td>
<td>ASTM D2240</td>
<td>70</td>
</tr>
<tr>
<td>Glass transition temp., °C (°F)</td>
<td>ASTM D3418</td>
<td>-32 (-25)</td>
</tr>
<tr>
<td>Crystalline melting temp., °C (°F)</td>
<td>ASTM D3418</td>
<td>63 (145)</td>
</tr>
</tbody>
</table>

Notes: (a) Data are typical and not intended as specifications; (b) Average molecular weight determined by gel permeation chromatography, source: E106239-09
**Contributes to low-smoke safety engineering**

With today’s tougher fire codes, flame and smoke resistance must be considered in the selection of all building materials. In commercial buildings, some of the most restrictive fire codes have been targeted at the plenum area, that air space immediately above ceilings where computer cabling and other device wiring is routed between connection points. To meet today’s rigorous plenum area fire codes, a number of cable manufacturers have turned to Elvaloy® KEE as the PVC flexibilizer of choice to reduce smoke potential while keeping the cable insulation flexible.

As architects and engineers consider further ways to reduce flame and smoke risk, all building materials are coming under review. Roofing and other waterproofing membranes based on Elvaloy® KEE offer a distinct advantage because they reduce the use of easily ignited liquid plasticizers which produce black, oily smoke.

**Available from leading membrane manufacturers**

PVC roofing membranes based on Elvaloy® KEE bring together attributes desired by quality-oriented contractors and building owners: toughness and flexibility in a thin profile; easy installation and repair; reduced smoke hazard; long-lasting resistance to pollutants, aging and brittleness; and the potential energy-savings of cool white roofing. Factor these benefits into your next roofing decision. Ask your contractor or system supplier to give you a choice based on DuPont™ Elvaloy® KEE, available from leading roofing system manufacturers worldwide.

---

For more information on the Web: [elvaloy.dupont.com](http://elvaloy.dupont.com)