DuPont Automotive

WHAT IS PPA?
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Polyphtalamides are a specific type of aromatic polyamide. Addition of an aromatic ring structure provides many advantages versus typical polyamides such as nylon 6 or 66.

These advantages are manifested as improved chemical resistance, better high temperature mechanical property retention, and higher retention of properties with moisture content.

ASTM D5336 defines a polyphthalamide (PPA) as “a polyamide in which the residues of terephthalic acid or isophthalic acid or a combination of the two comprise at least 55 molar percent of the dicarboxylic acid portion of the repeating structural units in the polymer chain”.

Resins with less than 55% aromatic di-acid content are not PPA resins. Fully aromatic polyamides such as DuPont™ Kevlar® are called aramids.
PPA Resins

Aromatic polyamides that have 55% or more aromatic diacid content (terephthalic, isophthalic acids)

- **Aliphatic**: 0%
- **Semi-Aromatic**: < 55%
- **Fully Aromatic**: 100%
- **Semi-Aromatic — PPA resin**: 55% or More

Examples:
- Zytel® PA66
- Zytel® PA6
- HTN53
- HTN51
- HTN52
- HTN54
- Kevlar® Nomex®
Effect of Temperature on Stress at Break

Zytel® HTN51G35HSL Retains Strength Well at Mid-Range Temperatures. HTN52G35HSL Performs Even Better at Higher Temperatures.
Effect of Moisture on Tensile Strength

Zytel® HTN PPA Parts Offer High Tensile Strength Under Humid Conditions, Especially with HTN51G35HSL.

D.A.M. 50% RH

ASTM D638

Tensile Strength, psi

0 10,000 20,000 30,000 40,000

HTN51G35HSL  HTN52G35HSL  PA66 33%GR  PA6T/6I/66 33%GR

D.A.M.  50% RH
Zytel® HTN PPA Has Better Chemical Resistance to Automotive Fluids at High Temperatures than PA66 and PA6T/6I/66.

ASTM D638

<table>
<thead>
<tr>
<th>Chemical Resistance After Aging (%)</th>
<th>Synthetic Motor Oil</th>
<th>Auto Transmission Fluid</th>
<th>Power Steering Fluid</th>
<th>Zinc Chloride, 10%</th>
<th>Fuel Methanol, 15%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temp., °C</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>60</td>
<td>23</td>
</tr>
<tr>
<td>Time, hr</td>
<td>3,000</td>
<td>3,000</td>
<td>1,000</td>
<td>1,000</td>
<td>8,760</td>
</tr>
</tbody>
</table>

HTN51G35HSL, PA6T/6I/66 33%GR, PA66 33%GR
DuPont™ Zytel® HTN Has Long Proven History in Delivering Cost Effective Solutions…

…under the Harsh and Demanding Automotive Environment to our Customers Throughout the World
DuPont™ Zytel® HTN51 Provides…

- **Dimensional Stability, Rigidity and Strength**
  - Resonators
  - Brake Booster
  - Motor Housing
  - Headlamp Adjuster

- **Electrical Insulation, SMT soldering**
  - High Voltage Bushings
  - Motor Insulator
  - Connector

- **Hydrolysis and Chemicals Resistance**
  - Water Heater Manifold
  - Valve Body for Shower
  - Fuel Module

…Rigidity, Strength, Dimensional Stability, Electrical Insulation, Chemical Resistance at High Temperatures and Humid Condition