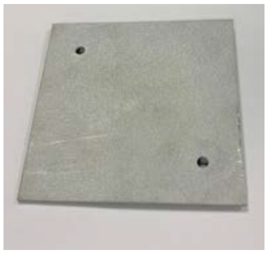
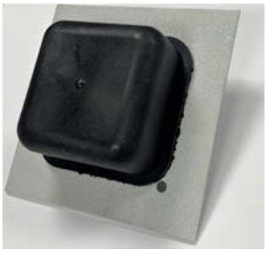
SOLUTION SHOWCASE

Celanese

NOVEL SOLUTION SIMPLIFIES MANUFACTURING BY ENABLING DIRECT PLASTIC-ALUMINUM JOINING

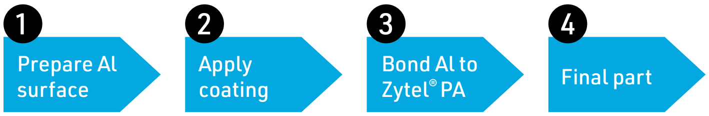



To test burst strength of the ZytelBond™ Bonding Technology, the team injection molded a test cube that would represent a typical polyamide component (left). An aluminum plate was pre-treated to remove aluminum oxide (right), then ZytelBond™ Bonding Technology was applied.




The Zytel® PA polyamide cube was joined to the aluminum plate via hot plate welding (left). Cube is 65 x 65mm, plate is 1.5mm Aluminum series 5000. Burst pressure testing showed cohesive failure. The welded Zytel® PA cube firmly bonded onto the aluminum plate and failure occurred in the weld joint and not at the interface between metal and Zytel® PA (right).

ZYTEL® PA BONDING SOLUTION PROCESS STEPS



In step 1, aluminum oxide is removed from the aluminum part surface via methods such as water sanding, wet blasting, or plasma/laser treatments. In step 2, ZytelBond™ Bonding Technology is applied via spray, brush, dip, or other methods at room temperature. The coating is activated in Step 3 by overmolding plastic onto an aluminum insert or by hot plate welding a previously molded Zytel® PA part to the aluminum component. The method chosen depends on the geometry of the final hybrid aluminum-plastic component.

IMPROVED BONDING STRENGTH VERSUS OVERMOLDING AND WELDING

In a recent development project, Celanese Engineered Materials investigated new solutions for joining polyamides and aluminum via chemical bonding. Specifically, the team performed extensive testing and formulated a joining solution that bonds Zytel® PA polyamides with aluminum, a common challenge for automotive and industrial components. The result is a new, unique technology called ZytelBond™ Bonding Technology, a liquid solution that is applied to an aluminum surface before being activated via hot plate welding or overmolding.

This next-level joining technology enables a strong, structural bond between aluminum and polyamides. It leads to higher burst, tensile and shear strength than conventional adhesives, mechanical interlocking, and mechanical assembly methods. Other advantages include ease of application at room temperature (the coating can be sprayed, brushed, dipped, or even applied to a substrate in an injection mold), and long shelf life (up to 3 years).

This new bonding technology is compatible with multiple polyamide chemistries, including PA6, PA610, PA612, PA66, and PPA. All of these polyamide materials are available within the Zytel® PA and Zytel® HTN portfolios.

Applications that can benefit from this technology are many. It is being used in development of hybrid cooling plates, a critical EV application in which a polyamide component is welded to an aluminum plate to improve thermal management of batteries. Testing shows that the high strength of Zytel® PA polyamides and aluminum also meets requirements and offers design flexibility for multiple automotive and industrial applications, including:

- EV battery plugs
- Structural components, e.g., beams, brackets, pillars, mounts
- Components involved in NVH reduction
- Filters
- Modules
- Housings
- Clips
- Quick connectors
- Flow leads

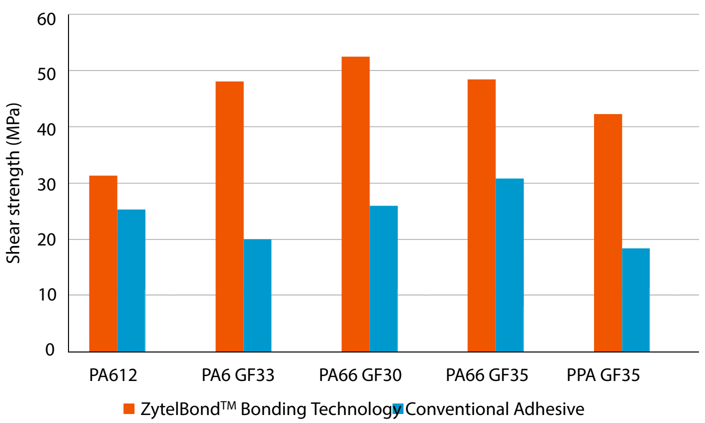
BURST PRESSURE TESTING RESULTS

	Test & condition		Zytel® HTN51G35EF	Zytel® PA 70G35EF
burst (bar)	@ new		9	15
	After ageing in Water/Glycol	@90°C - 1000h	6	12
		@90°C - 2000h	5	11
		@90°C - 3000h	4	11
	After ageing in Dielectric Oil	@100°C - 3000h	8	14
	After thermal shock [-30 to 150°C] x 50cyles		9	15

Source: Celanese

Burst pressure testing shown on page one was performed in several conditions – new after assembly; after ageing in water/glycol and dielectric oil; and after thermal shocks. Materials tested were 35% glass filled grades of PPA and PA66. Burst tests were performed at 23°C.

SHEAR STRENGTH TESTING RESULTS



Source: Celanese

Lap shear strength tests were performed using ZytelBondTM Bonding Technology and a conventional adhesive. Depending on the material tested, bonded samples had anywhere from 2x to 8x higher shear strength.

WHY JOIN ALUMINUM AND ZYTEL® PA POLYAMIDE?

Joining Zytel® PA and aluminum combines the unique strengths of both materials. Aluminum provides excellent thermal and electrical conductivity, high stiffness and strength, and properties that remain constant regardless of temperature, moisture levels, and ageing. Zytel® PA polyamides, on the other hand, supply thermal and electrical isolation, a wide range of grades, and greater design freedom that leads to functional integration possibilities.

Commonly used joining methods include:

- Mechanical assembly – metal fasteners plus some form of sealing
- Mechanical interlocking – adding undercuts and surface roughness
- Bonding technologies – chemical connections

ZytelBondTM Bonding Technology improves on the third method and delivers significantly better burst strength and greater shear/ tensile resistance for a stronger bond, while simultaneously simplifying manufacturing versus mechanical assemblies or interlocks.

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Form No. 001-20854-HMC0123