DuPont™ Zytel® HTN

high performance polyamide resin

Product guide and properties

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The miracles of science™

ZYTEL® HTN high performance polyamide
Bridging Extremes

ZYTEL® HTN cost effectively bridges the performance gap between conventional engineering resins and high-end specialty polymers. With a balance of chemical, moisture and temperature resistance, plus outstanding process-ability, our family of high performance polyamides is engineered to take on the challenge of demanding environmental conditions.

Pictures on the cover

1. **Oven fan**
   The use of ZYTEL® HTN has enabled to design a fan with excellent air discharge and extremely low noise by taking advantage of ZYTEL® HTN low warpage, dimensional stability and property retention at high temperatures.

2. **VW heater circuit valve**
   ZYTEL® HTN provides excellent chemical resistance against coolants and dimensional stability.

3. **Phone jacks by FCI**
   FCI chose ZYTEL® HTN because of its good SMT capability and easy moulding.

Description

ZYTEL® HTN is a family of semi-aromatic polyamides that are suited for a wide range of high performance applications in the Automotive, Electrical & Electronic and Industrial & Consumer industries.

The ZYTEL® HTN resins show a unique combination of properties:

1. **Low effect of moisture**
   - Excellent retention of properties
   - Good dimensional stability
2. **Good high temperature properties**
   - High melting point (up to 310° C)
   - Elevated glass transition temperature (T_g up to 140° C DAM)
   - High heat deflection temperature (HDT up to 288° C)
3. **Chemical resistance**
   - Motor, transmission and transformer oils
   - Fuels
   - Glycols
   - Water, steam
4. **Surface Mount (SMT) compatibility,** which makes ZYTEL® HTN the material of choice in several SMT connector applications
5. **Excellent electrical properties**
   - High tracking Index – CTI: 600 V for the HB grades and 525 V for most FR (flame retardant) grades
   - Retention of dielectric strength over a wide temperature range
6. **Dimensional stability**
   - Minimized warpage
   - Low coefficient of linear expansion (CLTE)

Due to these unique features, ZYTEL® HTN is the ideal candidate not only in the presence of elevated temperatures but whenever dimensional stability, retention of properties in humid environments, creep resistance, chemical resistance or excellent electrical properties are key to success.

Resonator Daimler Chrysler-A-Class
ZYTEL® HTN was selected because of its high peak temperature resistance and good heat ageing.

Modular phone jack by Tyco Electronics
AMP chose ZYTEL® HTN because it is suitable for IR reflow soldering and has good flow.

Products and Compositions

ZYTEL® HTN can be:
- Unreinforced
- Glass reinforced
- Mineral reinforced
- Flame retardant

Three ZYTEL® HTN families are currently available:

- **ZYTEL® HTN "51"**
  High performance semi-aromatic polyamide series, showing, minimum moisture absorption, low warpage, superior chemical resistance, excellent dimensional stability and heat aging performance above 175°C.

  In addition, it retains the modulus almost unchanged up to 140°C, due to its high T_g.

  For best part performance mould temperatures of 140°C to 160°C are recommended.

- **ZYTEL® HTN "52"**
  High performance semi-aromatic polyamide series, "cold" mouldable **(mould temperatures: 80 to 130°C)**, with high melting point (310°C) and HDT (up to 288°C) and even better heat aging performance below 170°C. These grade are also suitable for SMT (Surface Mount) components such as connectors and coil formers.

- **ZYTEL® HTN "53"**
  High performance semi-aromatic glass reinforced polyamide, developed for structural applications requiring high stiffness and impact resistance with low moisture sensitivity that can be processed in **water heated moulds** (mould temperature: 80 to 120°C).

- **ZYTEL® HTN "54"**
  High performance semi-aromatic glass reinforced polyamide, developed for structural applications requiring high stiffness and impact resistance, good retention of properties at elevated temperatures, with low moisture sensitivity that can be processed in water heated moulds (mould temperature: 80 to 120°C).

  To choose the best grades for a given application you can refer to figures 1, 2 and 3.

Figure 1 represents the ZYTEL® HTN families as function of the moisture absorption and T_g (glass transition temperature).

In this respect ZYTEL® HTN "51" series is the best in-kind choice due to its lowest moisture pick-up rate and highest T_g.

The radar charts in figures 2 and 3 indicate which grade of ZYTEL® HTN is the best candidate based on the selection criteria.

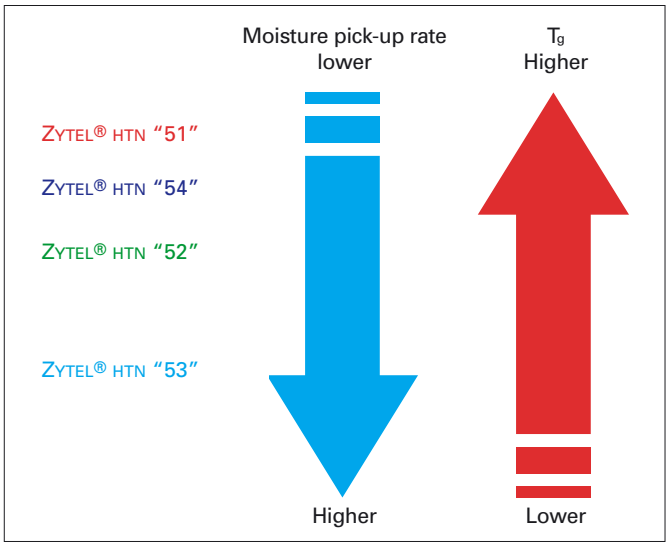


Fig. 1 **ZYTEL® HTN "51" family has lowest moisture pick-up rate and highest glass transition temperature (T_g)**

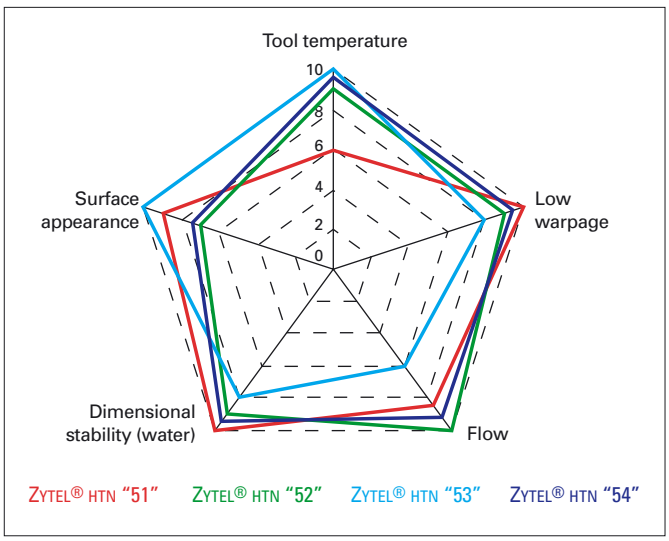


Fig. 2 **ZYTEL® HTN family positioning**

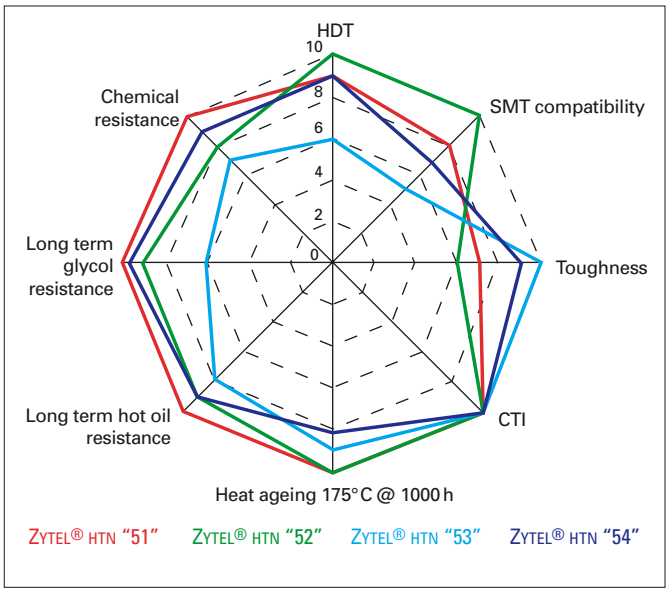
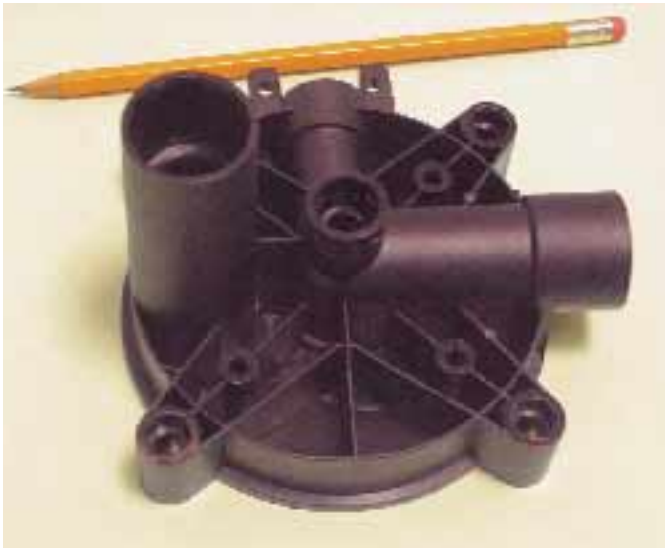


Fig. 3 **ZYTEL® HTN family positioning**

Applications

ZYTEL® HTN is used for a broad variety of applications in the following areas:

- **Automotive**
  air induction: resonators, **climatization:** thermostat housings, **engine cooling:** water outlets, **fuel system:** fuel rails, **auto electronic:** connectors, ignition coils.
- **Electrical and Electronics**
  electronic components: SMT and wire harness **connectors,** branching and control: **circuit breakers** housings and components, transformer bushing wells, **electrical components:** coil formers, motor armature insulators, switches and relays.
- **Industrial and Consumer**
  HVAC: boiler manifolds and diverting valves, **small appliance:** steam iron needles, **powertool:** gearhousing, **large appliances:** oven fans and glass holders.



Boiler manifold by Baxi
Baxi chose ZYTEL® HTN due to its high dimensional stability, low warpage and hydrolysis resistance.

Processing

ZYTEL® HTN can be processed on conventional injection moulding machines and extrusion equipment.

ZYTEL® HTN resins are shipped in moisture resistant bags with less than 0,2% moisture level. For optimum properties, the resin should be dried to 0,1%.

As for the moulding conditions, you can find the basic parameters in the relevant datasheets.

Detailed recommendations for processing ZYTEL® HTN resins can be obtained from DuPont sales and distributors offices listed in the back of this brochure.

VW heater circuit valve housing
Chemical resistance to long-life coolants is a unique benefit of ZYTEL® HTN. Ultrasonic welding capability low swell and excellent dimensional stability are key requirements ZYTEL® HTN matches very well.

ZYTEL® HTN grades

HTN51G15HSL	15% glass reinforced, heat stabilized lubricated
HTN51G25HSL	25% glass reinforced, heat stabilized lubricated
HTN51G35HSL	35% glass reinforced, heat stabilized lubricated
HTN51G35HSLR	35% glass reinforced, heat stabilized lubricated, hydrolysis resistant
HTN51G45HSL	45% glass reinforced, heat stabilized lubricated
HTN52G35HSL	35% glass reinforced, heat stabilized lubricated, water heated moulding
HTN53G50HSLR	50% glass reinforced, heat stabilized lubricated, high stiffness and toughness, water heated moulding
HTN54G35HSLR	35% glass reinforced, heat stabilized lubricated, high stiffness and toughness, water heated moulding
HTN54G50HSLR	50% glass reinforced, heat stabilized lubricated, high stiffness and toughness, water heated moulding
HTNFE18502	unreinforced toughened, water heated moulding
HTNFR51G35L	35% glass reinforced lubricated, V-0 at 0,8 mm
HTNFR52G15BL	15% glass reinforced lubricated, V-0 at 0,8 mm, water heated moulding
HTNFR52G30BL	30% glass reinforced lubricated, V-0 at 0,8 mm, water heated moulding
HTNFR52G35BL	35% glass reinforced lubricated, V-0 at 0,8 mm, water heated moulding
HTNFR52G45BL	45% glass reinforced lubricated, V-0 at 0,8 mm, water heated moulding

Properties of ZYTEL® HTN

	Property**	Test method	Test condition		SI Unit	HTN51G15HSL Preliminary* DAM	cond.	HTN51G25HSL Preliminary* DAM	cond.
MECHANICAL	Stress at break	ISO 527-1/2	5 mm/min	23°C	MPa			170	
	Tensile strength	ASTM D638				123			
	Strain at break	ISO 527-1/2	5 mm/min	23°C	%			2,2	
	Elongation at break	ASTM D638				2			
	Tensile modulus	ISO 527-1/2	1 mm/min	23°C	MPa			9000	
		ASTM D638							
	Flexural modulus	ASTM D790		23°C	MPa	6210			
		ISO 178							
	Izod impact strength (notched)	ISO 180/1A		23°C	kJ/m²			8,5	
				–30°C				8,3	
	Charpy impact strength (notched)	ISO 179/1eA		23°C	kJ/m²			8,9	
				–30°C				8,7	
	Izod impact strength (unnotched)	ISO 180/1U		23°C	kJ/m²				
				–30°C					
	Charpy impact strength (unnotched)	ISO 179/1eU		23°C	kJ/m²			46	
				–30°C				43	
THERMAL	Heat deflection temperature	ISO 75-1/2	1,80 MPa		°C			263	
		ASTM D648	1,80 MPa		°C	245			
		ISO 75-1/2	0,45 MPa						
	Coefficient of linear thermal expansion	ASTM E831	Parallel	55°C-125°C	E⁻⁴ 1/°K				
			Normal	55°C-125°C	E⁻⁴ 1/°K				
	Glass transition temperature	ISO 11357-3			°C	141		141	
	Melting temperature	ISO 3146C			°C	300		300	
ELECTRICAL	Relative permittivity	IEC 60250	1 MHz						
	Dissipation factor	IEC 60250	1 MHz		E⁻⁴				
	Volume resistivity	IEC 60093			ohm cm				
	Surface resistivity	IEC 60093			ohm				
	Dielectric strength	ASTM D149	1,6 mm	23°C	kV/mm				
			1,6 mm	150°C	kV/mm				
	CTI	IEC 60112			V				
	CTI M	IEC 60112			V				
FLAMMABILITY	Flammability	UL94	0,75 mm						
	Glow wire flammability	EC 60695-2-1	3 mm		°C				
			2 mm						
			1 mm						
	Oxygen index	ISO 4589			%				
OTHERS	Density	ISO 1183			g/cm³	1,31		1,38	
PROCESSING	Melt temperature range				°C	320-330		320-330	
	Mould temperature (Injection moulding-)	ISO 294			°C	130-160		130-160	
	Drying temperature				°C	100		100	
	Drying time, dehumidified dryer				h	6-8		6-8	
	Air dew point				°C	<–20		<–20	
	Processing moisture content				%	<0,1		<0,1	
	Mould shrinkage		Parallel	1,6 mm	%	0,4			
			Parallel	3,2 mm	%	0,45			
			Normal	1,6 mm	%	1,0			
			Normal	3,2 mm	%	1,1			

* The data are preliminary and subjet to change as additional data are delivered. ** Data are referred to NC only with the exception of 51G15HSL BK083, 51G25HSL BK083, HTN51G35HSLR BK420 and HTNFR52G45BL BK337.
All the above information is subject to the disclaimer printed on the back page of this document..

HTN51G35HSL		HTN51G35HSLR Preliminary*		HTN51G45HSL		HTN52G35HSL Preliminary*		HTN53G50HSLR Preliminary*		HTN54G35HSLR	
DAM	**cond.**	**DAM**	**cond.**	**DAM**	**cond.**	**DAM**	**cond.**	**DAM**	**cond.**	**DAM**	**cond**
220	210	220	210	240	230	220	180	262	220	178	
2,4	2,1	2,4	2,1	2,4	2,1	2,1	2,7	2,8	3,2	3,0	
12500	12500	12500	12500	15000	15000	12500	12000	17600	17600	10115	
10300				13700		10200				9137	
11	11	11	10	12,5	12,5					12,5	
11				12							
		12	11	11	11			15	14	11,7	
				12							
50	40					40	40			32	
65	55	65	44	85	75	45	45	100	95	86,6	
56				61							
264		264		264						255	
						288					
276		276		276						281	
0,15		0,15		0,15		0,15					
0,52				0,49		0,77					
141		141		141		90		80			
300		300		300		310		256		300	
4				4,5							
120				180							
$1E^{15}$				$1E^{15}$		$1E^{15}$					
$1E^{14}$				$1E^{14}$		$1E^{15}$					
27,1				25,7		27,5					
23,6				24,5		1,9					
600				600		600					
250				250		325					
HB		HB		HB		HB					
960						960					
800						750					
750				750		750					
23				24							
1,47		1,47		1,58		1,47		1,60		1,420	
320-330		320-330		320-330		320-330		280-300		320-330	
130-160		130-160		130-160		60-130		80-120		85-105	
100		100		100		100		100		100	
6-8		6-8		6-8		6-8		6-8		6-8	
<–20		<–20		<–20		<–20					
<0,1		<0,1		<0,1		<0,1		<0,1		<0,1	
0,2		0,2		0,1		0,25				0,2 (2mm)	
0,3		0,3		0,2		0,3					
0,9		0,9		0,9		1,0				0,5 (2mm)	
0,9		0,9		0,9		1,0					

Properties of ZYTEL® HTN

	Property**	Test method	Test condition		SI Unit	HTN54G50HSLR Preliminary* DAM	cond.	HTNFE18502 DAM	cond.
MECHANICAL	Stress at break	ISO 527-1/2	5 mm/min	23°C	MPa	230			
	Tensile strength	ASTM D638						63	
	Strain at break	ISO 527-1/2	5 mm/min	23°C	%	2,6			
	Elongation at break	ASTM D638						15	
	Tensile modulus	ISO 527-1/2	1 mm/min	23°C	MPa				
		ASTM D638							
	Flexural modulus	ASTM D790		23°C	MPa	14000		1800	
		ISO 178							
	Izod impact strength (notched)	ISO 180/1A		23°C	kJ/m²				
				–30°C					
		ASTM D256		23°C	J/m				
	Charpy impact strength (notched)	ISO 179/1eA		23°C	kJ/m²	15,6			
				–30°C					
	Izod impact strength (unnotched)	ISO 180/1U		23°C	kJ/m²				
				–30°C					
		ASTM D4812		23°C	J/m				
	Charpy impact strength (unnotched)	ISO 179/1eU		23°C	kJ/m²	110			
				–30°C					
THERMAL	Heat deflection temperature	ISO 75-1/2	1,80 MPa		°C				
			0,45 MPa					114	
	Coefficient of thermal expansion	ASTM E831	Parallel	55°C-125°C	E⁻⁴ 1/°K				
			Normal	55°C-125°C	E⁻⁴ 1/°K				
	Glass transition temperature	ISO 11357-3			°C				
	Melting temperature	ISO 3146C			°C	305		304	
ELECTRICAL	Relative permittivity	IEC 60250	1 MHz						
	Volume resistivity	IEC 60093			ohm cm				
	Surface resistivity	IEC 60093			ohm				
	Dielectric strength	ASTM D149	1,6 mm	23°C	kV/mm				
			1,6 mm	150°C	kV/mm				
	CTI	IEC 60112			V			600	
	CTI M	IEC 60112			V				
FLAMMABILITY	Flammability	UL94	0,75 mm					HB	
	Glow wire flammability	EC 60695-2-1	3 mm		°C			750	
			2 mm					750	
			1 mm					700	
	Oxygen index	ISO 4589			%				
OTHERS	Density	ISO 1183			g/cm³	1,60		1,10	
PROCESSING	Melt temperature range				°C	320-330		325-335	
	Mould temperature (Injection moulding-)	ISO 294			°C	80-120		60-100	
	Drying temperature				°C			100	
	Drying time, dehumidified dryer				h	6-8		6-8	
	Air dew point				°C	<–20		<–20	
	Processing moisture content				%	<0,1		<0,1	
	Mould shrinkage		Parallel	1,6 mm	%				
			Parallel	3,2 mm	%			0,3	
			Normal	1,6 mm	%				
			Normal	3,2 mm	%			0,5	

HTNFR51G35L		HTNFR52G15BL Preliminary*		HTNFR52G30BL Preliminary*		HTNFR52G35BL Preliminary*		HTNFR52G45BL Preliminary*	
DAM	**cond.**	**DAM**	**cond.**	**DAM**	**cond.**	**DAM**	**cond.**	**DAM**	**cond.**
165								175	
165	162	134		172		186			
1,4								1,4	
1,3	1,4	2,8		2,2		2,1			
15000								16000	
12400		6700		11400		13000			
								14500	
14								12	
14									
		69		115		115			
11								13	
13									
		690		800		900			
40									
40									
255		275		283		285		285	
270								300	
0,18				0,13					
0,60				0,86					
141		90		90		90		90	
300		310		310		310		310	
$1E^{16}$				$1E^{16}$					
$1E^{13}$				$1E^{13}$					
24,5				18,7					
21,6				2,9					
525		400		525		525			
225		225		175		225			
V-0		V-0		V-0		V-0		V-0	
960		960		960		960			
960		960		960		960			
960		960		960		960			
1,65		1,53		1,62		1,67		1,76	
315-325		325-330		325-330		325-330		325-330	
130-160		60-130		60-130		60-130		60-130	
100		100		100		100		100	
6-8		6-8		6-8		6-8		6-8	
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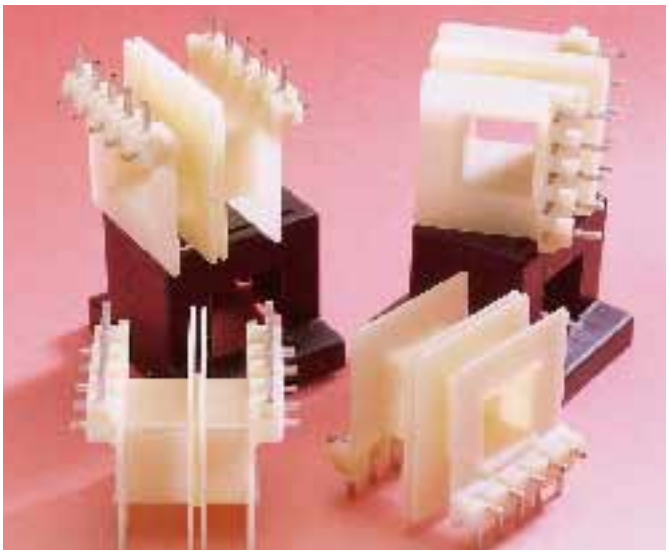
0,1		0,4		0,2		0,2			
0,2									
0,8		1,1		0,9		0,9			
0,7									

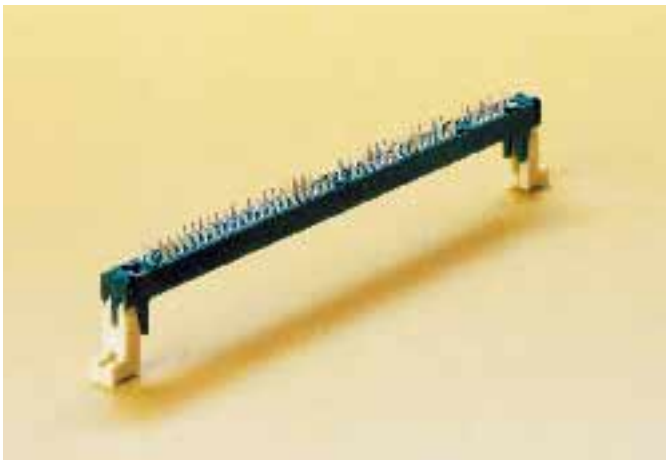
* The data are preliminary and subjet to change as additional data are delivered.

** Data are referred to NC only with the exception of 51G15HSL BK083, 51G25HSL BK083, HTN51G35HSLR BK420 and HTNFR52G45BL BK337.

Steam iron needle by Braun
ZYTEL® HTN is used because of its high temperature deflection properties and melting point, as well as for easy moulding.



Coil formers by Miles Platts
ZYTEL® HTN provides good electrical properties at high temperatures and meets UL requirements for the end-use.



DIMM II connector by Tyco Electronics
AMP chose ZYTEL® HTN for their DIMM II connectors because of its excellent high temperature capability for IR reflow solder, high flow in thin-walled sections and good dimensional stability.

SCA2 connector by Molex
Molex chose ZYTEL® HTNFR52G30BL for their SCA2 connector due to excellent temperature resistance, high mould flow making possible very thin walls, and an excellent balance of physical properties.

Daimler Chrysler/Woco CDI engine resonator
ZYTEL® HTN was chosen due to excellent heat ageing retention of strength and stiffness at elevated temperatures and low warpage with easy assembly. The main benefit was a reduction in cost due to high productivity and easy weldability.

Motorbike engine cover
ZYTEL® HTN provides better dimensional stability at high temperatures and lower warpage than standard PA66.

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