Charge-Air Cooler End Caps

Stanyl®

a DSM Brand

Astonishing Stanyl®

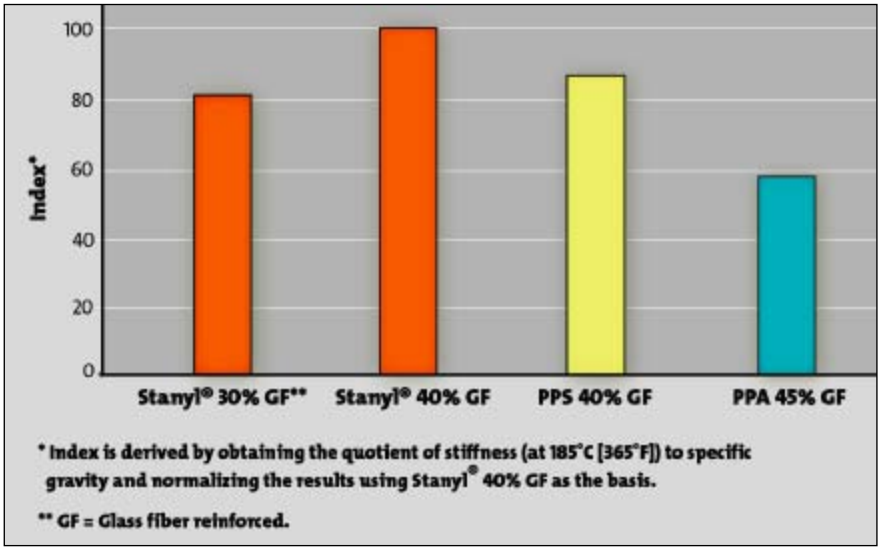
Charge-Air Cooler End Caps

Turbocharged engines yield added horsepower and weight.

The demand for economical high output from small engines has driven the motor vehicle OEMs to use turbochargers for boosting horsepower. Added components translate to added weight which counters other efforts to increase fuel economy. Turbocharger and engine cooling suppliers have been challenged to minimize the added weight in these systems without sacrificing system performance. Replacing metal with engineering plastics in system components has led to a focus on charge-air coolers as well as air ducts.

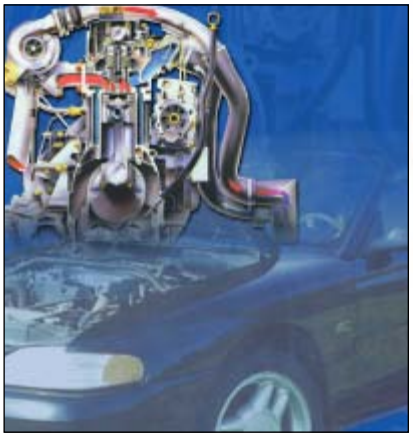
Proven success of engineering plastics in radiator end tanks made charge-air cooler end tanks an obvious area to explore. Unlike radiators, charge-air coolers are typically air-to-air heat exchangers. Charge-air reaches temperatures over 200˚C (392˚F) so cast aluminum has traditionally been the metal of choice due to its high temperature performance, stiffness and strength, and its relatively low weight. Any charge-air cooler end tank made from engineering plastic would need to have similar performance, be much lighter, and offer lower costs. With the demands of charge-air temperatures exceeding 200˚C (392˚F) , high internal pressures, vibration fatigue and shock, a true high temperature engineering plastic was needed.

Figure 1 Normalized stiffness to weight ratio at 185˚C (365˚F).



Stanyl® - a proven performer in charge-air cooler end caps.

Stanyl® high performance polyamide, a proven performer in charge-air cooler end caps, is used internationally by all of the major charge-air cooling system suppliers for their most demanding charge-air cooler end caps. Stanyl® has superior elevated temperature creep resistance, when compared to other high temperature engineering plastics, so sealing integrity at elevated temperatures is very robust. It has the best stiffness to weight ratio (above 120˚C [248˚F]) (see Figure 1), which means you need less material to make a high performance component. Stanyl® offers design and manufacturing possibilities that cost more with other



Stanyl® allows you to make lightweight, cost-effective charge-air coolers that are capable of withstanding high pressures, stresses, and heat loads.

high temperature engineering plastics both in material, processing, and weight. If you're looking to reduce weight and lower cost by replacing metal in charge-air cooler end caps, Stanyl® is the best material choice.

Stanyl® ensures sealing integrity at elevated temperatures.

Stanyl® exhibits superior elevated temperature stress relaxation resistance when compared to other high temperature engineering plastics (see Figures 2 and 3). During assembly the crimping operation of the metal tube header to the end cap imparts a substantial stress on the plastic material. Stanyl® offers a significant increase in stress relaxation resistance over other high temperature polymers.

This resistance to relaxation is important in order to maintain an adequate seal load, ensuring an airtight assembly. Thanks to its high level of crystallinity, Stanyl® offers the best combination of creep resistance, stress relaxation resistance, and specific gravity of all the high temperature polymers, especially at temperatures above 120˚C (248˚F).

Figure 2 Relaxation behavior (dry-as-molded).

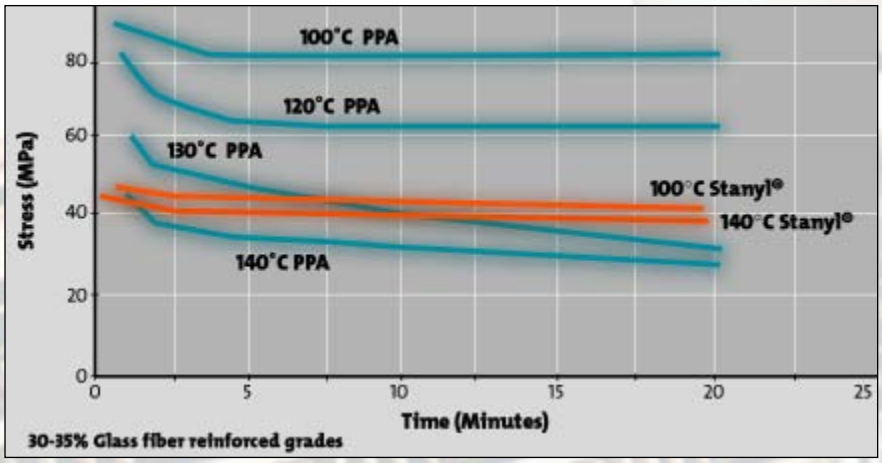
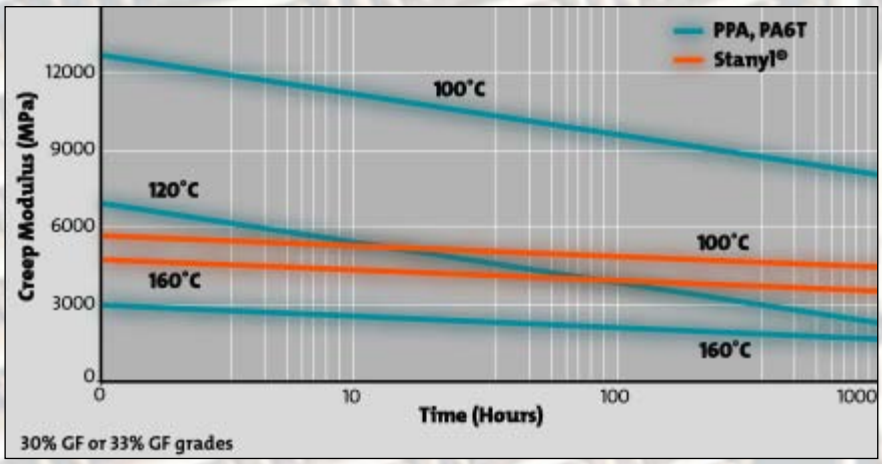


Figure 3 Creep modulus: Stanyl® vs. PPA, PA6T.



Turbo charging systems become lighter in weight and economically attractive due to the use of Stanyl® in end cap material.

Stanyl® with 30% glass fiber reinforcement is 8.5 - 14.5% lighter than PPS with 40% glass and PPA with 45% glass. Because of its lower specific gravity, a Stanyl® end cap is significantly lighter than either of these other two materials. Stanyl® with 40% glass fiber reinforcement is 4 - 67% stiffer at 185˚C (365˚F) than either of these two other materials (its specific gravity is still lower than either of these). Due to the exceptional strength of Stanyl® an end cap that is thinner (and lighter) than end caps made from either of the two other materials is possible. Yet, stiffness remains unchanged!

Consider a simply supported beam at 185˚C (365˚F). Due to the varying moduli of the four materials, each beam will have a different thickness in order to obtain equivalent stiffness. Using a basis of Stanyl® +30% glass reinforcement, the relative thickness of the beam for the other three materials are listed in Table 1.

Table 1 Comparisons per beam with equivalent stiffness at 185˚C (365˚F).

	Stanyl®	Stanyl®	PPS	PPA
	30% GF	40% GF	40% GF	45% GF
Relative Thickness	100%	92%	93%	109%
Relative Beam Weight	100%	98%	108.5%	118.7%
Relative Price	100%	100%	116%	96%
Relative Beam Cost	100%	98%	126%	114%

Assumption: 250,000lb/yr annual consumption

Taking into consideration the different specific gravities, Table 1 lists the relative beam weights for the materials. Using Stanyl® will allow a designer or engineer to develop a part that is thinner and lighter than if they were to use either of the two other materials. Now, combine this with the relative unit price of the other materials to see what these parts with the same stiffness will cost (see Table 1).

Charge-air coolers are used to cool down the turbocharged air in order to obtain the maximum power out of diesel engines. The charge-air cooler and the plastic end caps have to withstand temperatures over 185˚C (365˚F) with pressures up to 1.15 bar. Stanyl® TW200F6, well suited for this high demanding application, demonstrates an excellent fatigue resistance and an E-modulus of 4,700 MPa at 185˚C (365˚F).

Stanyl® offers the best combination of creep resistance, stress relaxation resistance, and specific gravity for charge-air cooler end caps.

Further, due to its rapid rate of crystallization, Stanyl® will cycle up to 20% faster than the other materials. Because of that, on an annualized basis, using Stanyl® can reduce your per-part molding cost by 20% (see Table 2).

Not only will Stanyl® process faster, but because of this speed you will realize significant savings in machine operating expenses. Furthermore, using Stanyl® will give you up to 20% extra capacity with your existing equipment!

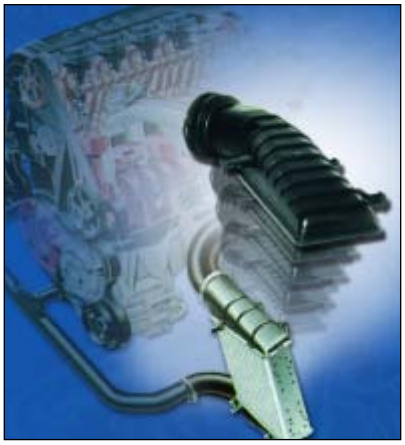
Only Stanyl® can offer you the combination of weight and cost savings along with superior high temperature performance and faster processing. Stanyl allows for the production of turbocharging systems that are lighter weight and less expensive!

Stanyl® is the answer for the performance and cost challenges posed when replacing metal in charge-air cooler end caps. Ensuring sealing integrity with its resistance to stress relaxation at high temperatures is just the beginning. Couple that with excellent stiffness well above 120°C (248°F) with a low density and designers can make a robust, light weight end cap with less material and lower cost than with any other high temperature engineering plastic. Can you risk not capturing all the cost and performance benefits Stanyl® has to offer when replacing metal components?

Table 2 Relative molding costs with respect to cycle time.

	Stanyl®	Stanyl®	PPS	PPA
	30% GF	40% GF	40% GF	45% GF
Cycle Time	40 sec	40 sec	50 sec	50 sec
Cost per Part	$0.35	$0.35	$0.44	$0.44
Relative Cost	79.5%	79.5%	100%	100%
Capacity Utilization	80%	80%	100%	100%

Assumptions: 95% efficiency; $60/hr machine rate; 2-cavity mold



A 20% reduction in processing, time, and cost makes Stanyl® the material of choice for your application.

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