Plastic Parts, Inc.

Case Study: *Thermoplastic Encapsulation for Small Engine Stators*

Thermoplastic encapsulation, a custom injection molding technique used by Plastic Parts, Inc. is utilized to develop cutting-edge stators for Briggs and Stratton Corporation, maker of small engines for outdoor power equipment. The redesigned stators deliver the benefits of improved protection against heat and moisture, higher manufacturing yields and lower production costs.

Opportunity

Custom injection molder, Plastic Parts, Inc. (PPI), began working with Briggs and Stratton in 2008 to improve stator development — the essential component that creates energy to reliably recharge the battery to power accessories on small engines for power equipment such as lawn mowers, pressure washers and snow blowers. PPI saw the production levels as an ideal fit for a new manufacturing cell that the high volume over-molding work was well suited for.

Although the previous stators were very effective, PPI knew the advancements made in the design flexibility of engineering thermoplastics increased the potential to deliver an improved stator that better suits the performance requirements for the high-use engines. As a key supplier of stators for an industry-leading motor manufacturer for over three decades, PPI drew on its successful thermoplastic encapsulation technology to implement a new approach for the Briggs & Stratton stator.

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> *—Jeff Jorgenson, General Manager*

The previous stator incorporated a two-part component with a snap-on insulator clamshell, a design that could make assembly inconsistent when lining up precisely with engine bolt locations. PPI aimed to improve the stator quality with updated processes that increase durability and performance characteristics with a streamlined product design while at the same time reducing tool complexity, lowering assembly costs, and increasing production rate.

Solution

PPI began the stator improvement process by eliminating the secondary production step of assembling two parts together. The new system includes placing eight raw half stators into mold cavities to produce four over-molded parts. The molding operation incorporates high speed, high pressure, and precise cavity injection fill, providing an excellent outcome for molding materials designed for high thermal conductivity. The four rivets of each finished stator are precisely located on every part, because they are held in place as thermoplastic encapsulation forms the insulation.

The high velocity polymer fill takes place in a controlled system with instantaneous shut off to halt the fill process in the molding machine at the precise moment, critical for preventing variation. By closely controlling the amount of pressure, temperature, and timeliness of shut-off, the multi-cavity molds repeatedly yield consistent results without flashing or shorting despite the inherent slight differences in cavities.

PPI’s injection molding technology accepts varying thicknesses of lamination stacks, and enables precise monitoring and control of speeds, pressures and material viscosity throughout the encapsulation process. Since different tolerances of steel means no two lamination stacks will be exactly the same thickness, PPI made accommodations in the mold to accept varying thicknesses of the riveted stacks.

The optimal combination of thermoplastic base polymer, ground insulation, and magnet wire are utilized to meet application requirements for the defined environment of small engines for outdoor power equipment. By optimizing part design, tool design and process control, the plastic polymer encapsulates the lower temperature components and prevents damage to the thin insulating layer on each magnet wire.

Advantage

According to PPI general manager, Jeff Jorgenson, the process of streamlining to one-part encapsulation has provided numerous improvements for component characteristics and the bottom line. Additionally, thermoplastic encapsulation overmolding is advantageous for improving component reliability.

Quality improvement

The encapsulated stator provides excellent heat and overload protection and resistance to elevated temperatures, as well as improved moisture resistance. Encapsulation is a very effective method for achieving vibration and noise reduction by the inherent characteristics of encapsulated overmolding that utilize extremely tight control of the cavity pressure inside the mold cavity. The process includes a technique to remove all air gaps from the poles for improved electro-magnetic performance.

The new stator development process dramatically decreased part-to-part variation, improving location of the part to the engine for assembly. Bolting points are consistently placed to coincide with the mounting points on the engine block for immediate and proper alignment to secure bolting.

By utilizing high quality, American-made components including resin and steel that are sourced from inside the US, the PPI thermoplastic encapsulation method meets requirements for the rugged use of stators including heat, aging, resistance, strength, and consistently effective molding performance.

Lower overall cost

Use of thermoplastic encapsulation delivers cost reduction and performance improvements by eliminating manufacturing steps while component cycle count and cycle times are reduced. Besides offering flexibility and cost-effectiveness, this tooling concept allows for quick scale-up from prototype to production.

Thermoplastic encapsulation overmolding provides an accurate and repeatable process. Time to production was streamlined to achieve a successful solution with anticipated cost savings. Due to the confidence of Briggs and Stratton with PPI, the project went directly to production thus generating an additional cost savings by eliminating the prototype stage.

A significant savings is realized in the elimination of assembly and reduced shipping and handling. The previous two-part components no longer need to be shipped to and from third-party assemblers.

PPI sees an opportunity to use the same mold technology for varying engine sizes and is excited about the possibility for encapsulation in designs that present similar potential including modularity to make winding easier and reduce waste.