Case Study

DuPont Solutions for Robot Vacuums Provide High Performance, Style, and Durability

Project

Some owners speak with their robot vacuums; others just appreciate the results of their cleaning power. These small home appliances went from expensive novelty (costing up to $1,800 in 2001) to mainstream appliances in just a few years. Today, industry experts estimate that 20% of all vacuum cleaners sold worldwide are robots.

The rapid consumer acceptance of robot vacuums would have been impossible if not for advances in artificial intelligence and deep learning—as well as thermoplastics. In fact, polymer solutions from DuPont play a key role in the design of numerous models of these ubiquitous, once futuristic appliances.

Recently, a global leader in the design and manufacturing of robot vacuum cleaners approached the DuPont team seeking improved materials for its newest robot vacuum. DuPont design and materials engineers collaborated with the OEM to identify manufacturing and aesthetic challenges. Then the DuPont team customized solutions that provide high performance, style, and sustainability.

Challenge

Designers of robot vacuums face several challenges that must be addressed to make their product desirable to consumers and help achieve sustainability goals.

Must Be Durable Yet Not Damaging

Robot vacuums must have a durable housing, able to bounce off chair legs and other hard objects without damaging precision sensors inside the appliance.

Maximize Aesthetics, Minimize Noise

Consumers want a stylish look because robot vacuums spend most of their useful lives perched in a docking station waiting for their next mission—and visible to all. Additionally, noise must be kept to a minimum to help preserve a peaceful home environment.

Keep Weight to a Minimum

Reducing the weight of robot vacuums increases their range and makes it easier for consumers to carry them from room to room or between floors of a home.

Support Sustainability Goals

Materials selected for the robot vacuum need to help the manufacturer achieve its sustainable development goals.

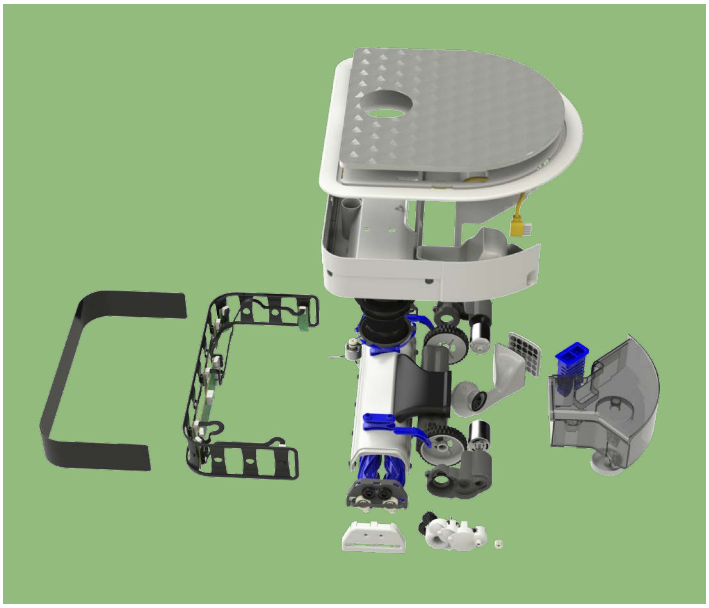
Solution

The research team at DuPont customized two products to meet the manufacturer's high standards for the robot vacuum's laser distance sensor (LDS) cover, gear box shell, drive gears, bottom bracket, water tank handle, and mop scraper.

The critical laser pressure sensor on the vacuum cleaner, an upgrade from earlier models, is made using DuPont™ Zytel® RS polyamide. This solution provides an optimized balance of high stiffness and suitable strength. The outstanding dimensional stability of the polymer contributes to the precision and sensitivity of the laser sensor.

The self-lubricating properties and strength of Delrin® POM makes it ideal material for manufacturing of the robot vacuum's gear system.

DuPont also provided Computer Aided Engineering (CAE) support that helped reduce time from initial idea to commercial introduction of this new appliance.



In addition to LIDAR covers and gears, DuPont materials help robot vacuum manufacturers optimize many components. This includes seals and gaskets, cleaning filaments, rollers, dampeners, motors, and connectors.

Results

In addition to providing the robot vacuum with strength, dimensional stability, and good looks, DuPont solutions also improved the manufacturing efficiency and performance of the gear system that drives the robot's wheels.

The robot vacuum's LIDAR cover is made with Zytel® RS. With up to 65% renewable sourced materials from biomass, this DuPont solution helps the manufacturer achieve its sustainability goals.

Plus, the vivid white color of the Zytel® RS compound provides the sophisticated aesthetic finish product designers sought.

Delrin®, a proven gear system solution, sets the robot in motion and helps the robot vacuum generate more power with less noise.

Two Portfolios of High-Performing Products

Available in multiple grades, Zytel® nylon resin products enable greater design freedom and better product performance. For example, Zytel® Plus high-performance polyamide resin resists aging in high-heat automotive engine parts. And Zytel® HTN delivers superior stiffness for products such as handheld devices.

Zytel® advantages include:

- Insulating, electrical resistance
- Heat resistance
- Chemical resistance
- Strength
- Stiffness
- Dimensional stability
- Easy processability
- Versatility
- Fatigue resistance

Zytel® RS resins contain between 20% and 100% renewably sourced material (by weight) derived from castor beans.

Delrin®, the stiffest unreinforced engineering polymer available, is the preferred choice by designers, extruders, molders, and brand owners, as it allows potential cost and environmental savings.

Delrin® advantages include:

- High stiffness
- Low friction and wear
- Fatigue resistance
- Chemical resistance
- Dimensional stability
- Low moisture pickup
- Temperature toughness

Plus, Delrin® Renewable Attributed base polymer is produced from 100% bio-feedstock from waste to meet ISCC Plus mass balance certification.

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