SLA Makes WALL-E Look Battered

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The "how to" for making parts fast

The real life WALL-E that visits newsrooms, tradeshows, and media had to look like the animated WALL-E from the movie. It takes a lot of care to make WALL-E look old and battered.

Physical WALL-E, a real robot built with SLA for tours, guest appearances, and trade shows.

Because the animated WALL-E from the movie has been around for a long time, his digital body had been weather-worn and beat up by the work he does – compacting trash and stacking it neatly. Computer animation allowed animators to create the look and feel of a well-worn WALL-E, but transferring that same look and feel to a 'real' robot was another story.

Pixar used sophisticated computer graphics to create the digital representation of this fun-loving robot. This digital data was well suited for rapid and precise fabrication of all of the external covers that comprise WALLE. Disney's Imagineering team chose to have those covers created on an SLA rapid-prototyping system.

The form, fit and overall appearance of the prototype SLA covers were validated with a working robot. Then final covers were prepared. These final covers for the traveling robot needed to be significantly tougher than the initial SLA covers, so advanced cast urethane covers were reproduced using a silicone tool created from the SLA masters. The Imagineering team has been a bit secretive about the details, but here's how that process often works.

First prepare a master pattern — created using SLA, CNC, or PolyJet technology — that is worked to a desired surface finish. Then carefully position tape in specific areas to create joint or parting line to assist with cutting the pattern out of the mold.

Build a mold box to enclose the master pattern. The box size is minimized so that the poured Platinum-based Silicone material is not wasted. The master is elevated off the floor of the box to allow the Silicone to surround the master. The material is allowed enough time to cure and then the cured mold is cut into two halves and the master pattern removed.

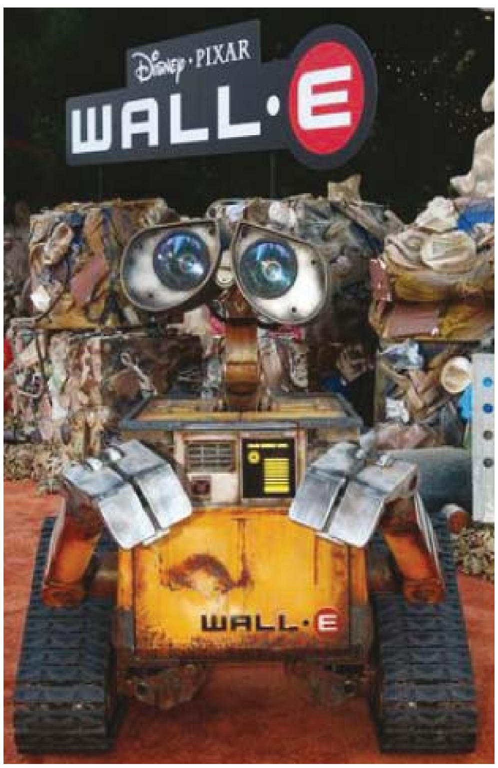
Mix a two-part polyurethane liquid and then pour (with a proprietary pressure differential) into the mold. The polyurethane filled mold is then placed into a pressure oven and the final cast polyurethane part is allowed to fully cure to maximum mechanical properties. Finally, the top half of the mold is removed and the final cast part is removed from the mold.

The stressing and rust texture for WALL-E was reproduced from the animated production using paint. "Exterior components – including the treads and details on the inside of the WALL-E camera eyes – were based on the movie data and placed 'on-model' to look as authentic as possible," according to Akhil Madhani, Principal Technical Staff Director for Walt Disney Imagineering Research & Development.

"For motion, the tracks are driven using custom designed brushless DC servomotors, which operate through planetary gearheads," Madhani said. The remaining motors are standard brushed motors using a variety of reduction mechanisms. All the mechanisms themselves were custom designed, including the tracks and treads. As with WALLE's panels, the tread texture was copied from the movie models.

Control software, as well as all the animation software, was written in-house at Disney and Pixar. This includes the system that allows the company to play Pixar-created animation on the physical robot in order to maintain its character.

Designing the 'real' WALL-E was, as many Disney projects, highly proprietary, allowing only for general information to be discussed. Madhani did say that "every part of the system, including electronics, was included in the CAD model." His team used Pro/engineer CAD software for design.



In the movie, WALL-E was a digital robot tasked with neatly stacking cubes of trash.

SLA Yields Accurate, Speedy Models/ Patterns

Form/fit prototypes, concept models, and master patterns for various casting techniques are created very quickly with Stereolithography (SLA), the most mature layer-additive rapid-prototyping technology available. Stereolithography is derived from two words: stereo (three-dimensional) and lithography (to print) thus to write or print in three-dimensions. The first commercial SLA system, the SLA 1 was demonstrated and announced in 1988 by 3D Systems. Since then the three major subsystems, the laser, the photopolymers, and the software have improved significantly.

The process is simple yet elegant. Ultraviolet energy from a focused laser beam is directed by dynamic mirrors to the free surface of a liquid photopolymer. The laser energy initiates polymerization of the scanned area resulting in precise curing or solidification. Each layer bonds or cures to the layer beneath itself (or a support structure); the z-stage indexes down one thin layer (typically 0.004 to 0.007 in.) and the process is repeated until the last layer is cured. The z-stage then raises the finished part and the surrounding liquid is drained off. The part is then placed in a post-curing UV oven, and finished to customer specifications.

Solid Concepts recently released ID-Light, a proprietary build style and assembly method for creating faster and lighter parts for large industrial applications. This product is about one-tenth the weight of solid SLA parts. For larger models this offers significant cost and time savings with the added benefit of being very easy to transport and handle.