FEA Helps Redesign a Pressurized Counter-Top Water Filter

Stein Design; Water Safety Corp.

Consumer Products

U.S.A.

www.stein-design.com; www.wscusa.com

ANSYS® DesignSpace®

Overview

Engineers often find complex parts — especially ones with modern ergonomic curves — difficult to analyze with traditional handbook thermal and stress analysis. As a small one-man design shop, Stein Design completes several such projects each year that benefit from the application of finite element analysis (FEA). The firm has used the technology to develop a wide range of plastic and cast parts for companies utilizing their services in providing fast-turnaround designs that meet unique engineering and business requirements. In the development of consumer products in particular, the firm recognizes that product aesthetics and visual impact are often critical elements in the commercial success of a product. In one recent project, Water Safety Corporation of America, in Nevada, U.S.A. commissioned Stein Design to complete a major redesign of their Essence™ counter-top drinking water filter, an appliance intended to be attractive as well as effective in turning ordinary tap water into better-tasting, healthier water.

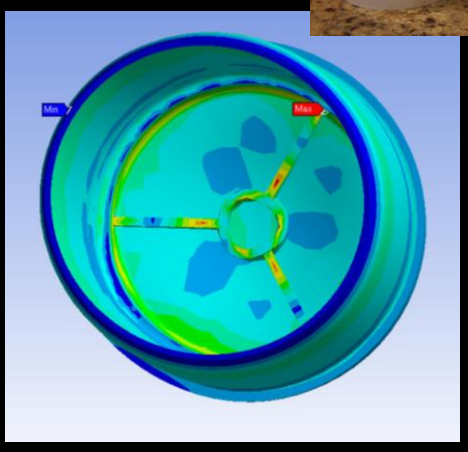
Testimonial

“ANSYS DesignSpace software is an integral part of many of our projects and part of the reason why the company has succeeded in the highly competitive engineering consulting business. Small consulting firms with no full-time analysts on staff can’t afford to spend a lot of time and money on training to run a complicated FEA program. Engineers who use ANSYS DesignSpace need little training to be highly productive, and the tool interfaces seamlessly with mechanical design software. Stein Design finds it very easy to make quick changes to the part geometry and to regenerate the DesignSpace FEA solutions to investigate ‘what-if’ scenarios early in the design process, when design changes have little impact on project schedules and tooling. Even though several months may pass between FEA applications, the software is designed so users can get up to speed quickly in producing meaningful results.”

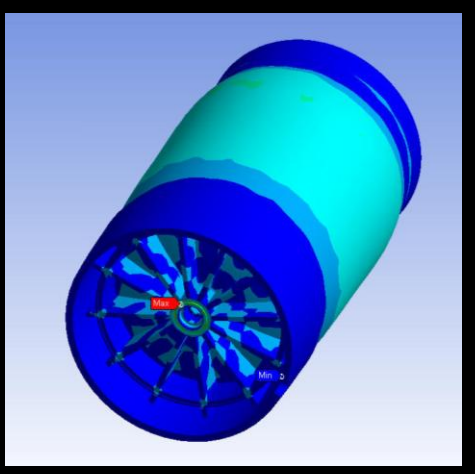
Signature here

Mathew Stein
President, Stein Design

A counter-top drinking water filter was redesigned to cut costs while making the product’s annual change of the carbon filter cartridge and flow meter battery more user friendly.



In spite of its 0.27-inch-thick bottom wall and three internal ribs, stress levels in the original water filter design exceeded the ABS material yield strength and showed up in red on the ribs, as displayed in this color-coded stress plot.



After the iterative process of testing various combinations using ANSYS DesignSpace software, the final design included a domed bottom surface with 12 radial ribs. The design lowered stress levels and wall thicknesses significantly, thereby cutting injection molding cycle time in half and lowering part cost by more than a third.

Challenge

The goal of the redesign was to cut production time and cost while making it easier for consumers to change the carbon filter cartridge and flow meter battery annually. The previous housing had incorporated thick walls to accommodate the hydrostatic pressure of 150 psi required for certification by the National Sanitation Foundation (NSF), a mark recognized for its value in international trade and respected by regulatory agencies. The thick walls resulted in slow injection molding cycle times, excessive material usage and an undesirably expensive housing. However, arbitrarily reducing material from the overall design could potentially cause part failures leading to water damage of consumers’ homes and high warranty costs.

Solution

FEA analysis of Water Safety’s existing product showed that in spite of its 0.27-inch-thick bottom wall and three internal ribs, stress levels were unacceptably close to the yield strength of the ABS thermoplastic material. In redesigning the housing, one of the primary concerns was reducing this maximum stress to half the material yield strength — thus providing a safety factor around 2.0 — while reducing wall thickness and injection molding cycle time. To arrive at an optimal design satisfying these complex requirements, Stein Design performed an iterative process of evaluating different wall thickness and rib combinations. Three-dimensional models were designed in a mechanical design package and then imported into ANSYS DesignSpace software.

Benefits

Once the initial pressure loads and boundary conditions were set for the first model, ANSYS geometry then could be quickly updated for each iteration. The iterative process of analyzing various rib and wall thickness combinations yielded a domed surface and 12 radial ribs. Maximum rib stress on the new design was reduced to 2,240 psi, giving a safety factor of 2.3 and exceeding the 2.0 target. At the same time, by reducing the nominal bottom housing wall thickness from 0.270 inch down to 0.170 inch, injection molding cycle time was cut in half and part cost was lowered by more than a third.