# More Power Please!

What do Tim, the Toolman, Taylor in the TV-Series “Home Improvement” and Raul Cano at Stanley Black & Decker have in common? The need for “More power!!”

By Boris Marovic, Industry Manager, Mentor Graphics

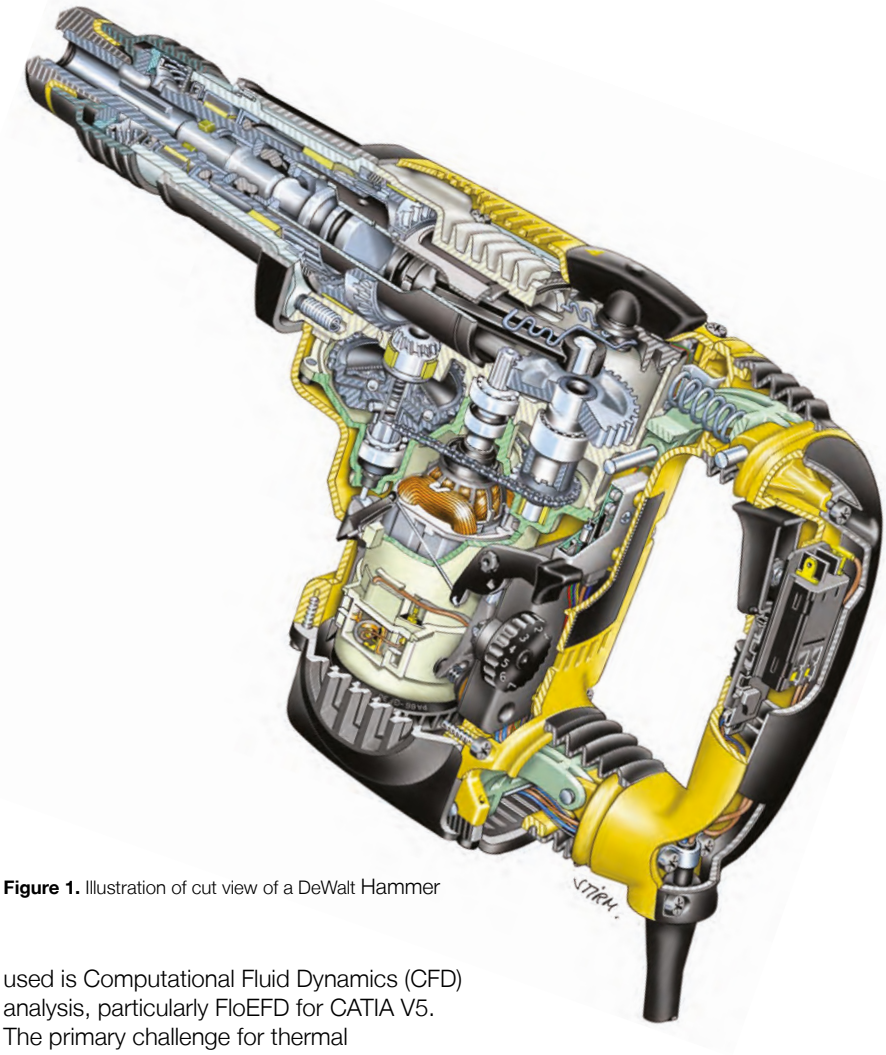

**Figure 1.** Illustration of cut view of a DeWalt Hammer

**Unlike Tim, Raul Cano is a professional and is the Lead Project Engineer CAE for Stanley Black & Decker’s DeWALT Professional Tools brand. He and his team are responsible for optimizing the performance of their hammer tools, namely the Rotary Hammer, Demolition Hammer, and Hammerdrills as well as concrete saws and dust extraction for large hammers.**

DeWALT’s reputation in the power tools and construction tools industry is unsurpassed. For almost 80 years DeWALT has earned a name for designing, engineering and building the toughest industrial machinery. The company incorporates their long standing tradition of state-of-the-art engineering into every product of their broad range of high performance portable electric power tools and accessories. Making DeWALT tools the number one selling brand of professional power tools in North America, and the fastest growing professional power tool brand in the world for the past five years.

The mission for professional tools from DeWALT is to deliver optimum performance and reliability. In order to achieve this, Raul’s team investigate several numerical simulations including drop, stress and thermal simulations. One of the methods used is Computational Fluid Dynamics (CFD) analysis, particularly FloEFD for CATIA V5. The primary challenge for thermal simulations is the need to process complex geometries such as the narrow spaces inside a handheld power tool where the motor, gearbox, and electronics are situated. This housing is built with stiffening ribs that not only makes such a power tool so robust but also complex. As with many, if not all, tools of this nature, the challenge is thermal. The use of FloEFD in their design process helps Raul to test design variations for venting, fan position and geometries, as well as housing changes for better airflow. In the case of the metal housings of the gear box, FloEFD is used to improve the cooling performance of the gear box.

Raul comments, “The capabilities of FloEFD to handle complex geometries allows us to simply switch between different component designs such as different fans and then let the software automatically mesh and calculate several variants over the weekend, is an enormous advantage for us.”

By having the ability to test so many variations of geometry it is possible to find the best solution for optimum airflow, both for quantitative flow rate and noise. With FloEFD, Raul is able to determine if a certain geometry change has a positive influence on the volume flow rate through the tool as well as find areas with very high velocities which can be indicative of a high noise source in the design.

The primary role of the airflow in the power tool is of course, thermal management. The better the airflow the more efficiently the motor can be cooled, thus allowing the power of the tool to be increased. One

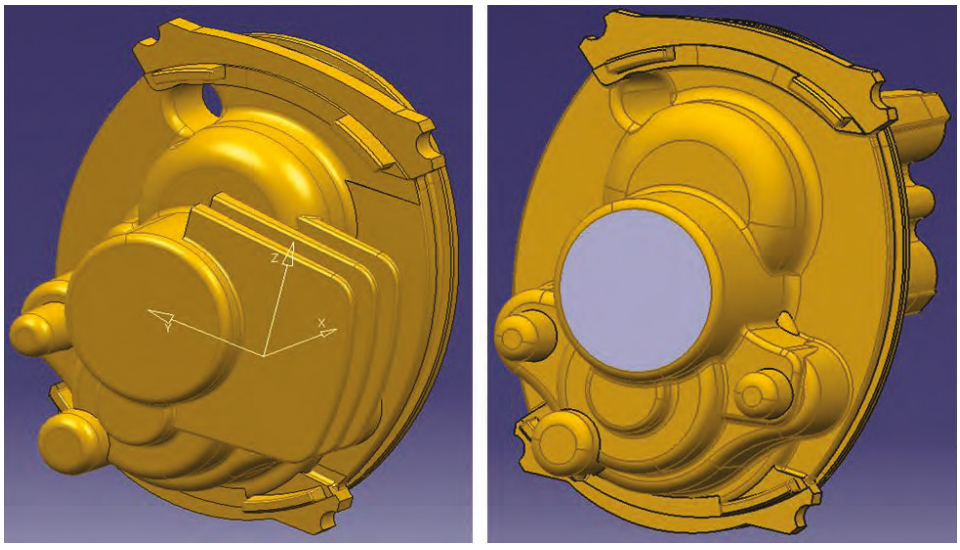

**Figure 2.** Bearing housing variants with (left) and without (right) cooling fins

study showed that an existing bearing housing design that contained fins for better thermal management, although it made the part more expensive and heavier, was still justified when compared to a housing version without the fins (Figure 2) as simulations have shown. In case of housing without the fins, the surface temperature of the external housing of the tool increases by 30°C in some regions (Figure 3).

In the case of the Large Hammer Dust Extraction – Hole Cleaning tool, the team at Stanley Black & Decker were able to reduce the wear of the hose attached to the unit and the vacuum cleaner. The wear at the hose was caused by the high concentration of concrete particles from the drilling of a hole that impacted the hose at a certain location causing a high abrasion rate. Just by optimizing the airflow path and its bends to reduce the impact of the particles, Raul was able to reduce the wear by around 60%. As a result the lifetime of the hose increased by a factor of two.

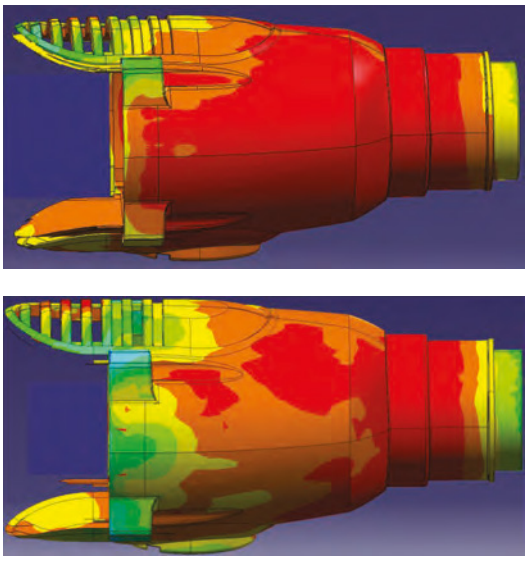

**Figure 3.** Temperature profile of external housing of a hammer showing the influence of the bearing housing without (top) and with (bottom) cooling fins

In another case, a range of simulation variants with different components of the Alligator Concrete Saw was conducted (Figure 4) to optimize the performance. The goal was to optimize the flow rate by makings changes to the fan, fan RPM and other components. The measurements in the lab at the end showed that even the noise was reduced by 10dB. A reduction of 10dB of noise is equivalent to around an eighth of the original noise (3dB equal half the noise).

The design of the power tools at Stanley Black & Decker are influenced by several departments and requirements. “If the drop test simulations don’t go well we have to redesign the housing which might make it necessary to change locations of venting openings. On another occasion the marketing department played with the rapid prototyped sample and found it is too thick or too long at a certain area of the housing which means we need to try to change it if possible and that often influences the flow paths in the tool that might reduce the flow rate due to too high pressure losses.” explains Raul. “All the desired changes have to be evaluated by multiple factors which might increase the price, the weight or size in one way or another. At the end of the process, the design has to perform at its best and the thermal simulations with FloEFD provide us reliable results to make sound judgments on the design changes we make.”

“Stanley Black & Decker uses several FloEFD licenses in our development centers in the US, UK and Germany and I have personally used it for over five years now with great success. We have several projects over a year and in each the number of simulation runs can vary from just a few to 20-30 simulations per project.” says Raul.

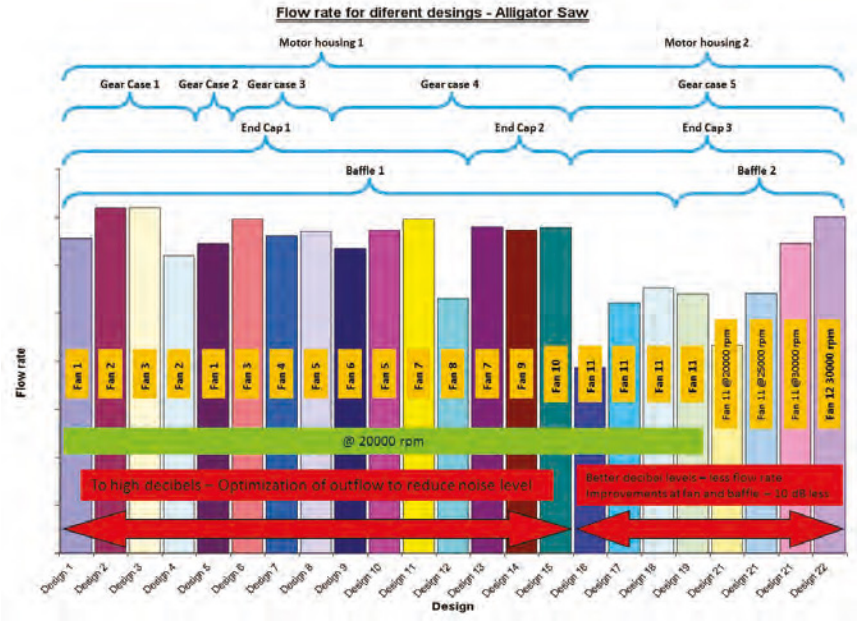


**Figure 4.** Flow rate variation of different component design iterations of the Alligator Concrete Saw