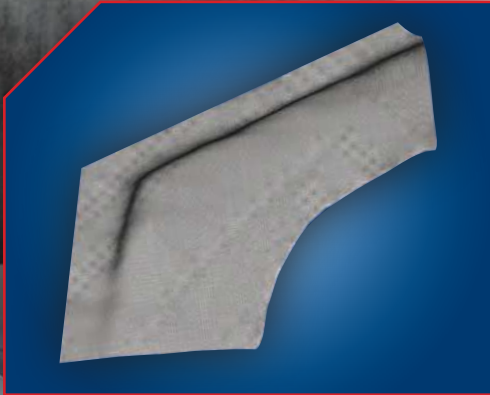


MoldMaking

TECHNOLOGY[®]



Inspecting Complex Product Profiles PG 34.



FEATURES
Cleaning Intricate Molds PG 37.

Tooling Up for Mold Machining PG 42.

CASE STUDY
Training for More Efficient Cold Runner Design PG 26.



moldmakingtechnology.com



Access video
at end of article.

Inspecting Complex Product Profiles

Using metrology software and a portable CMM, mold manufacturers can efficiently handle exceedingly complex surface profile requirements.

More than ever moldmakers are pressed to push the envelope on what is feasible and reasonable when it comes to accurately creating complex profiles. Companies today are heavily vested in each new product they bring to market. And good is not good enough. Manufacturing specs are often riddled with GD&T (Geometric Dimensioning & Tolerances) annotations that must be met and reported on in first article parts.

For a customer-centric brand these requirements are by no means unreasonable. Choices in the market breed competition, which in turns raises the bar on product form and function. Many customers don't even realize how much the emotional response to an object determines his or her relationship to it. Form has meaning; it can touch us at such a primal level that our mind is left scrambling to rationalize our emotional reactions.

Form (or Design)—in the context of both the natural and man-made world—has two jobs: to be the messenger of a certain experience and to fulfill on that promise. When the two don't match up, the experience is unfulfilling and its form superficial. Apple's excruciating attention to this level of detail is at the heart of the brand's customer experience and behind its unprecedented consumer loyalty. Apple's commitment to crafting this experience says simply that they care more about their customer than their competition.

It is obvious that a product's emotional value is increased from a positive visual, tactile and interactive customer experience. These emotional profiles are what the customer tends to focus in on. Strangely enough the less obvious and most critical profiles are functional; especially when the profile involves operational ergonomics and/or fluid dynamics. Failure to deliver in these areas can result in far more severe consequences than a mere misstep in product styling.

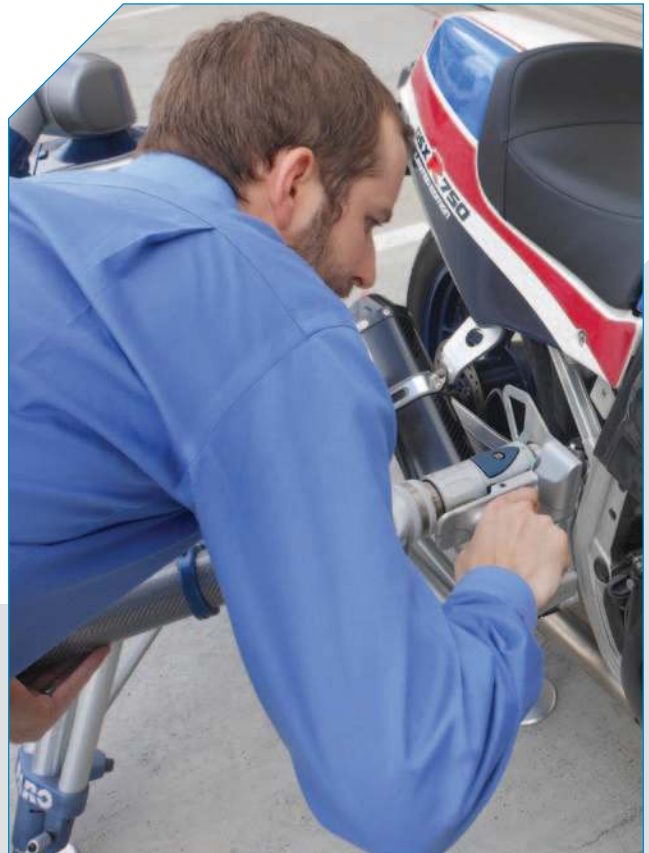


Figure courtesy of Verisurf Software, Inc.

The profile of this motorcycle's heat shield has been tested and refined for optimum performance. Any deviation to the intended profile can result in performance degradation or worse. Extremely tight tolerances over the entire profile are critical.



This underwater scooter is a great example of a beautiful sculpted shape that also has critical functional profiles. The flow around the scooter motor housing and through the propeller cage requires critical fluid flow design and manufacturing profile inspection to insure excellent underwater performance. Comfortable and ergonomic handle grips and low profile steering structure must also have low drag through the water.



Unique product styling, though challenging to manufacture, often is what appeals to consumers and ultimately drives design innovation.

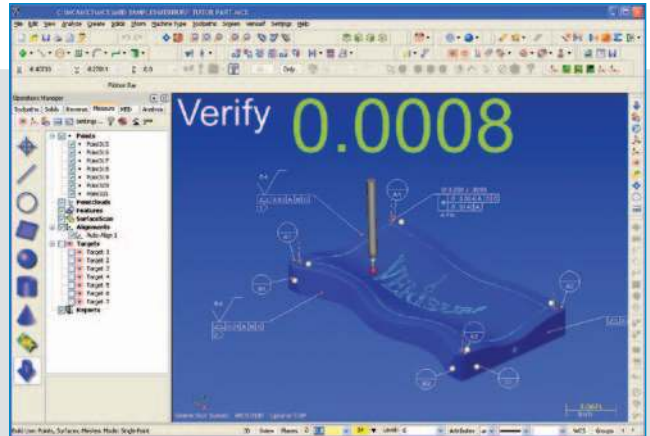
Companies make considerable investments in marketing research and industrial design to get the product profile just right. As a percentage of overall revenue, research and development of new products can range from 3 to 15 percent and more. For a Fortune 500 company today, this translates into billions of dollars spent every year just to make sure they get it right.

As a moldmaker this is all well and good, but it doesn't make your job any easier. More often than not it complicates things, especially when it comes to quality inspection and reporting.

Getting It Right

Today's parts often come with increasingly complex profiles, requiring a high degree of accuracy to ensure form, fit and function. Until recently, dimensioning and inspecting organic or free-formed profiles was a daunting task. These types of shapes are difficult to dimension and quite often they are a product of the artist's vision and not always geometrically grounded or they are a highly engineered functional shape that has been painstakingly optimized.

The key to successful inspection of a complex profile is a 3D CAD, which can come directly from your customer or design team, or can be reverse engineered from a physical part



Using reverse engineering software, physical models can be accurately digitized and dimensioned using GD&T annotations to illustrate nominal measurements for inspection.

or a prototype. Using metrology software and a portable CMM, either method works great and can accurately inspect surface profiles of plastic molded parts or tooling.

Model-Based Inspection

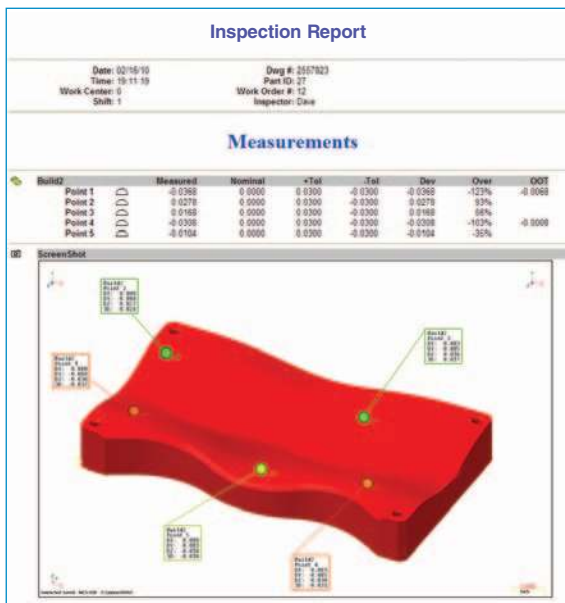
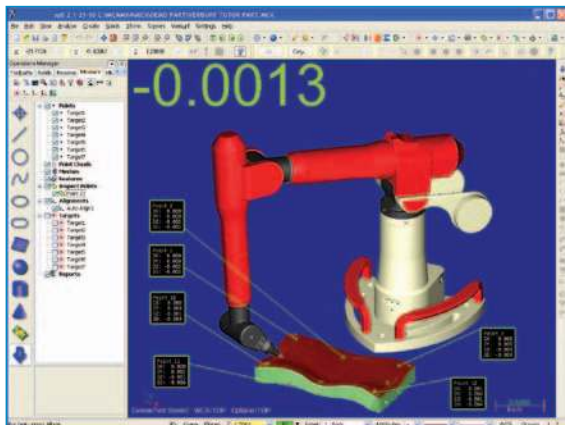
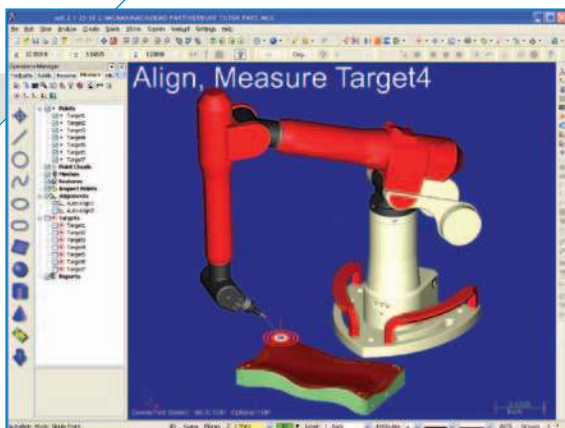
Model-based metrology software works with the 3D CAD file and portable CMM to ensure design intent, and eliminate the need for 2D inspection drawings, while closing the loop on digital workflow. CAD-based inspection is a good practical first step toward the goal of a complete MBD (Model-Based Definition) environment. The central concept embodied in MBD is that the 3D CAD model provides all of the detailed product information necessary for all aspects of the design intent.

CAD-based inspection involves inspecting the physical part measurements directly to the CAD model. Metrology software connects to and controls measuring devices such as scanners and laser trackers as well as stationary and portable CMMs. It also accommodates intelligent GD&T associated to the CAD model.

Intelligent GD&T datums are imported directly from the native CAD software with the 3D model and provide nominal dimensions and tolerances. In short, using a 3D measuring device, such as a portable CMM, metrology software becomes a conduit, accurately comparing a finished mold or part to its virtual 3D CAD likeness.

Model-Based Inspection Starting with a Physical Model or Prototype

The challenge of using a physical model or prototype as the inspection nominal is you need to digitize the model. Reverse engineering software is designed for just that purpose. Using a portable CMM with a laser line scan head attachment, instead of a touch probe, the physical part is painted into the software ('paint' is a term used to scan a part because the process is similar to spreading paint onto the part with a wide brush).



Align-Inspect-Report process. Align the CAD model to the part or tool using best fit alignment algorithms. Inspect the part to the CAD model nominal with model associated tolerances. Report the surface profile quality measurements with easily recognizable inspection locations and in or out of tolerance color indicators.

FIGURE 1

Where a touch probe might capture up to 100 data points per second and is excellent for high precision inspection, a scanner will capture 50,000 points per second, accurately capturing the most subtle design features. From the scanned data points, reverse engineering software creates meshes, surfaces, solids and prismatic features to create precise CAD models. Once the completed 3D CAD model is in place, it can be used for manufacturing, tool building or inspection—using the MBD inspection process outlined previously.

LEARN MORE

Visit our Inspection/Measurement Zone for more information on coordinate measurement machines and software, probes, vision systems, balance machines, calibrators and scanners. [Go to moldmakingtechnology.com/zones](http://moldmakingtechnology.com/zones) for a complete list.

Model Based Inspection of Plastic Mold Tooling

Using the 3D CAD model as the inspection nominal is great for inspecting plastic mold tooling as well as plastic molded parts. Most molds are machined with CNC machine toolpaths generated directly from a 3D CAD model, so inspecting the tool surface profile with the same 3D CAD model from which the toolpaths were created is an easy Align-Inspect-Report process (see Figure 1).

Summary

Using metrology software and a portable CMM, moldmakers can efficiently handle exceedingly complex surface profile requirements. Dimensioning, inspecting and reporting that used to be difficult, if not impossible can now be provided quickly and easily on molds or finished molded parts. [M.M.T](http://mmt.com)



VIDEO:
 Model-Based Inspection
<http://short.moldmakingtechnology.com/xinspect>

CONTRIBUTOR

David Olson is Director of Sales & Marketing for Verisurf Software, Inc.

FOR MORE INFORMATION:

Verisurf Software, Inc. / david.olson@verisurf.com / verisurf.com