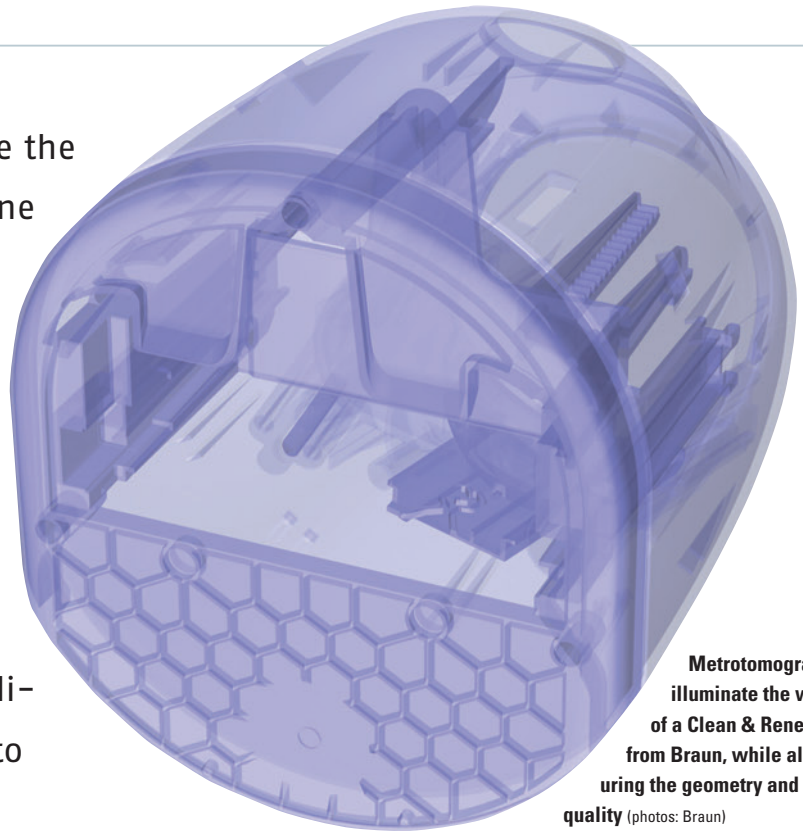


Metrotomography. To illuminate the inner workings of its products, one manufacturer of electrical appliances uses metrotomography, a non-destructive test method, for quality assurance. The method, which links computer tomography to the coordinate measuring, reduces the testing costs and extends testing capabilities, from product development to assembly control.



Metrotomography can illuminate the workings of a Clean & Renew system from Braun, while also measuring the geometry and surface quality (photos: Braun)

Looking for Clues with X-Rays

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Everyday objects such as toothbrushes and shavers have to keep improving in terms of design and quality. As product life cycles become shorter, the demands on development and manufacturing processes are increasing, too. Between each step in product development, the esthetically shaped prototypes must be repeatedly checked for compliance with engineering specifications.

Metrology in the Service of Development

Small electrical appliances, such as shavers, toothbrushes and hair dryers must meet the high requirements regarding both quality and esthetics of Procter & Gamble Germany GmbH & Co Operations oHG (P&G), Schwalbach am

Taunus, Germany. Their products have not only to be esthetically pleasing, but also are very often assembled from components made of different materials (plastics, metals) which increases their complexity.

The requisite injection molds are developed and manufactured in the company's Quality Innovation Center at their Kronberg, Germany, site. The various intricate components must fit together exactly. When shoppers look at a product as they weigh up a purchase, they unconsciously appraise the quality of the surface first. Then, they satisfy themselves that the product is fit for purpose. Most components are manufactured in their millions. Once they have gone to produc-

tion, it is extremely expensive to rectify design and process errors. If products which meet these quality requirements are about to reach the mass-production stage, they must be supported every step of the way by high-quality metrology.

Wish List for Basic Conditions

The Linear Measurement department is one of many involved in developing products. In 2007, its members set out to find an alternative measuring method that would boost the quality of the articles even further and optimize the level of interaction between the various departments during the development phase. Existing tactile metrology was having more and more difficulties analyzing the complex shape of the parts. Not only that, but the method entailed a great deal of time and technical effort. What was needed was a speedy and full report on the dimensional accuracy and quality of the parts.

Methods employing tactile and optical metrology are unable to measure complex internal geometries and complex

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Translated from *Kunststoffe* 4/2010, pp. 30–32

Article as PDF-File at www.kunststoffe-international.com; Document Number: PE110368



Fig. 1. The project manager prepares the test setup for a shaver: here he is adjusting the height of the electric shaver for the X-ray section

surface shapes in the round or to analyze porosity in parts without destroying them. This type of metrology is time-consuming, and the parts to be measured cannot be subsequently used for other studies. The answer to this problem came from Carl Zeiss Industrielle Messtechnik GmbH, Oberkochen, Germany: a combination of computer tomography (CT) and coordinate measurement (**Title picture**) called metrotomography. Initial trials with the technology demonstrated its fitness for purpose. The plastics used by the processor, such as ABS, PET and PE, exert no influence on the quality evaluation. In February 2008, the center in Kronberg was one of the first to acquire a Metrotom 1500 CT coordinate measuring machine.

The View Inside

P&G had already been using coordinate measuring machines from Carl Zeiss. Metrotomography meets the imposed requirements by generating data from complex three-dimensional parts quickly, efficiently and very accurately. CT affords a way of looking inside the finished products and finding air pockets in the structural elements. "This used to be a very complicated process," says the project manager for computer tomography at Braun GmbH, Kronberg. "The parts had to be cast in resin and then cut into slices." And even then, the cause of the material defect often could not be detected. Not infrequently, the defect was located directly at the cut edge of the milled mate-

rial. The metrotom works by analyzing the assembled product without the need for expensive and time-consuming sample preparation (**Fig. 1**). The article is soon tomographed and the result can be evaluated graphically as a solid model (**Fig. 2**). The model is then non-destructively measured on-screen and examined for material defects.

A further application of the instrument is that of assembly control (**Fig. 3**). If a malfunction occurs in a product, metrotomography quickly isolates the cause, allowing assembly, material, production and design flaws to be uniquely identified. The resulting image data are self-explanatory and can be accessed by everyone involved in development. The scanned data are archived for years and can be retrieved for further research and analysis.

Departmental Interaction

This previously unknown system has further improved the evaluation capa- →

! Profile

The **Procter & Gamble Quality Innovation Center** is housed in Kronberg im Taunus. The facility provides metrological services for all production sites. The team of five chiefly supports the Linear Measurement and Materials Engineering department in Kronberg in the development of products from Braun, Gillette and Oral-B. Their services are also available to all other company brands.

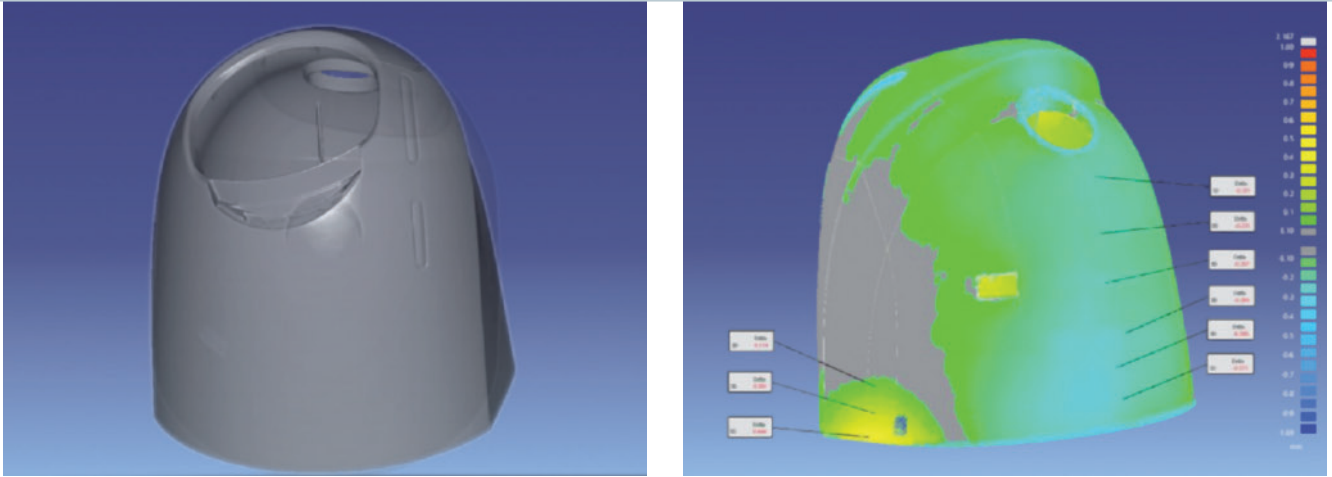


Fig. 2. The Clean & Renew system automatically cleans the electric shaver later. After scanning of the surface quality (left) and the internal geometry (Title picture), a set point-actual comparison is made with the CAD model and evaluated in the form of a false-color plot (right)

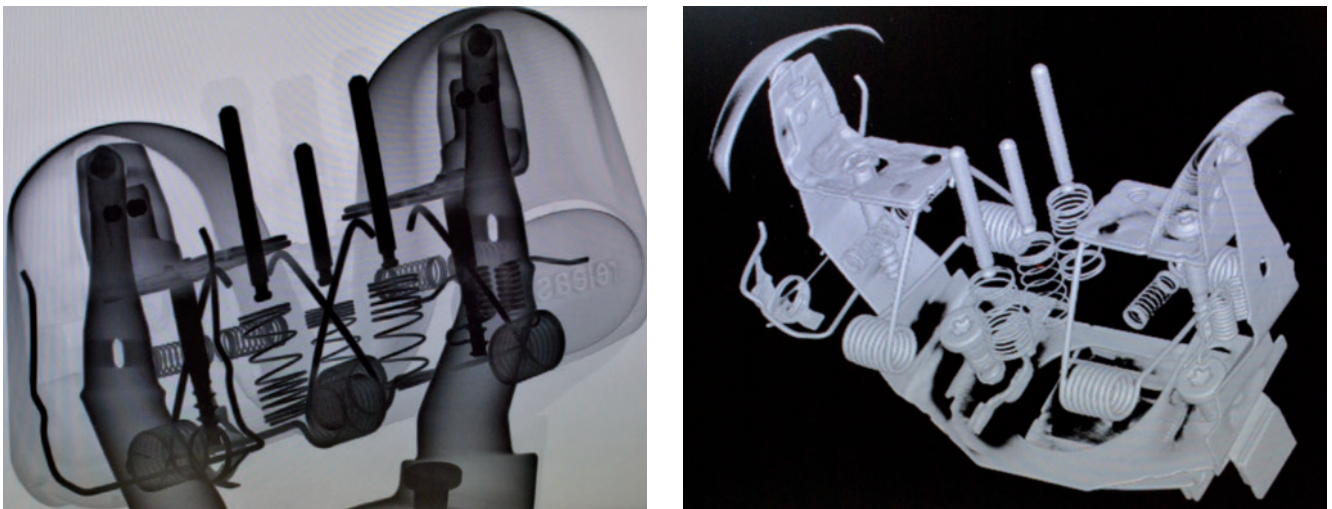


Fig. 3. Metrotomography can isolate malfunctions. Left: Illuminated shearing head of a shaver, showing springs, pins and screws; right: corresponding solid model for comparison

bilities of the company's metrology department. The experience of the Quality Innovation Center is that communications between the various departments were enhanced on account of the possibilities that Metrotom offers in the field of metrology and materials analysis. Above all, employees from the design, development and production de-

partments are now frequently to be found in the metrology department, availing of the services of the computer tomograph. ■

THE AUTHORS

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