3D measurement on shock absorber pistons

When manufacturing pistons for automobile shock absorbers, very tight tolerances must be adhered to regarding shape and surface parameters, and this despite high throughput. It is difficult for tactile measurement systems to attain the necessary reproducibility because of the discontinuous shape of the workpiece and the low position of the surface to be measured. White-light interferometry as an optical measurement technology in contrast provides an areal 3D data acquisition of the entire surface and all faces within seconds with a high level of repeatability.

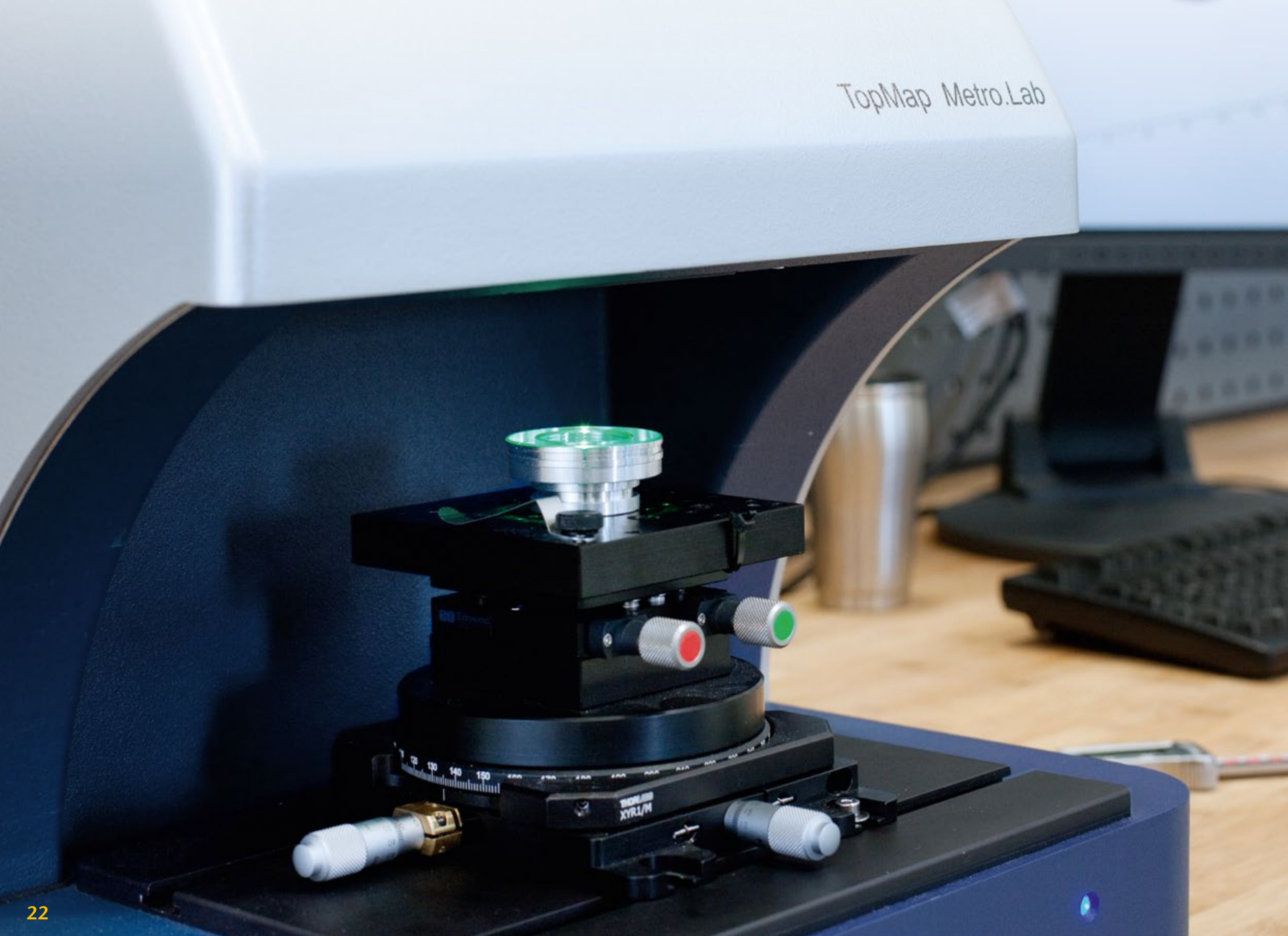


Figure 2: 3D optical surface metrology measures and visualizes step height, parallelism and further form parameters in a single measurement

Requirements of shock absorber pistons

Shock absorbers absorb vibrations or dampen movement. Their widespread use in industry and in the automobile sector have given rise to numerous technical solutions for various problems. In a motor vehicle for example, shock absorbers are safetyrelevant components and are also important for comfort.

Conventional car shock absorbers convert the kinetic energy into heat. This is done through resistance that a working piston has to overcome in a tube filled with oil. Shape and parameters of the piston are optimized for the special damping properties of the respective task. The working piston has orifices to allow flow through.

The shape of particular surfaces impacts on the flow characteristics. The workpiece may also have to be manufactured to fit additional components precisely, such as valves. This means that tight tolerances need to be complied with, even when producing larger numbers of pieces. White-light interferometry over large surface areas is very appropriate for quality control of such components. So far, surface measurements have predominantly been carried out using tactile methods. With this method however, measurements on flatness and waviness parameters and determining height differences, flatness or parallelisms is difficult and time-consuming. For tactile measurement systems, the uninterrupted shape of the workpiece and the deep position represent a great challenge when trying to achieve the necessary reproducibility.

3D characterization of the piston

White-light interferometry as an optical measurement technology provides the topography of all the surfaces within seconds, with a high level of repeatability. In Figure 2 you can see a 3D profile of the faces in the piston interior and in Figure 3 the topography of the lateral face

Figure 3: Topography of the lateral face and of two inner faces.

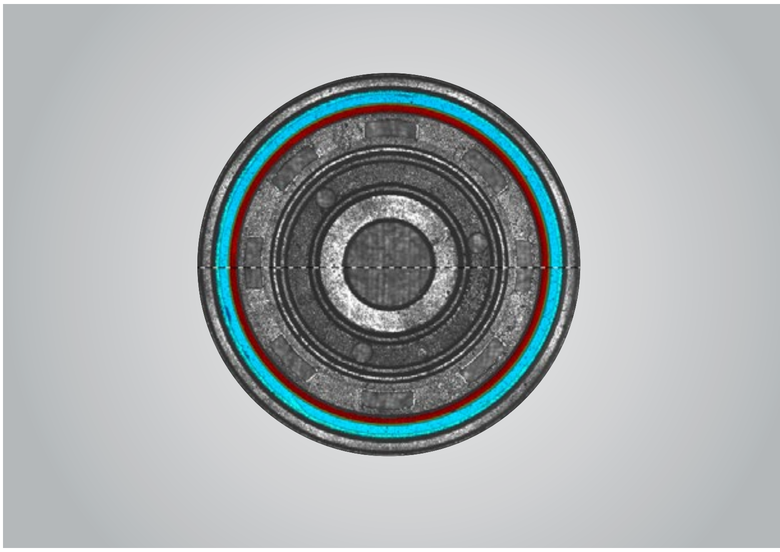
and two deeper interior faces. Polytec TMS software enables hiding certain regions by setting masks to analyse individual sections with more details. Figure 4 shows the upper face with its lacerated inside edge and the profile of deeper inside ring faces.

The geometric parameters, such as angles, slopes or height differences can easily be determined. Determining circular line profiles is also possible. For rotationally symmetric surfaces, this is the center of the circle which can also be ascertained automatically with the aid of software. Starting which such an „anchor point“, it is possible for example to evaluate a circular line profile with a constant position on the workpiece. As whitelight interferometry over large surface areas covers entire surfaces in one measurement, you can determine the values for parallelism and flatness very quickly.

White-light Interferometry in manufacturing

Even though this method can be used to determine deviations in the complete topography in manufacturing often only a few parameters are relevant for quality control. In the above example, these were the height difference between the two ring surfaces and their flatness. Such measurements can be made automatically.

Thanks to the concept of measurement recipes, all acquisition and evaluation settings of a measurement can be saved and the operator performes the measurement with just one click.The program can issue the measurement values with additional information, such as parts number, date and time, etc. Depending on the measurement task, the measurement may only take a few seconds.



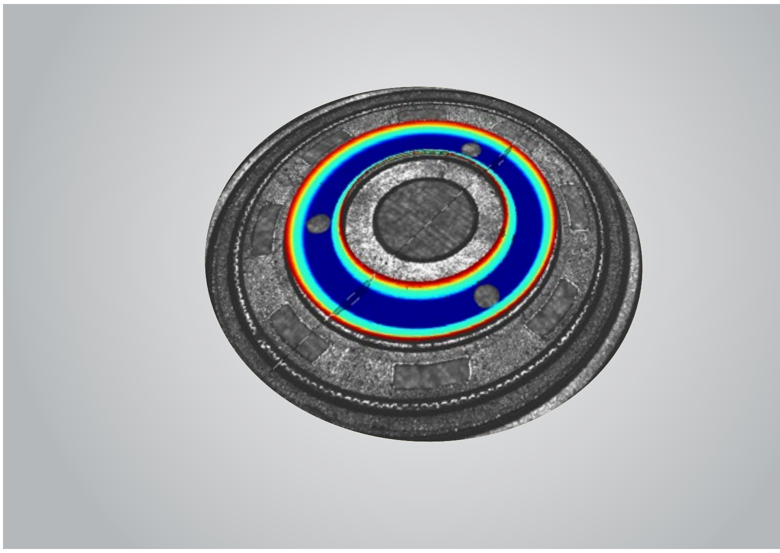


Figure 4: 3D and line profile of olnly the upper face (above); 3D profile of the deeper ring face (below)