

Different signals, one result

Complete inspection of sheet metal plates with combined thickness / distance measurement system

If flexibly rolled or welded sheet metal plates do not meet the predetermined specifications and this is recognized not until the further processing in the forming technology, this is not only annoying, but sometimes also cost-intensive. An automotive supplier shows that there are other ways: they check complete sheet metal plates with a special solution already on their arrival.

The GEDIA Automotive Group develops and manufactures structural parts and assemblies for the lightweight automotive body production as well as chassis components for the automotive industry. With more than 3,300 employees worldwide, the company achieved a turnover of over 480 million euros in 2015.

„We also process tailored rolled or welded blanks, i.e. flexibly rolled or welded sheet metal plates, which we receive from our suppliers according to our specifications,“ explains Marc Witzmann, quality engineer at Gedia Gebrüder Dingerkus GmbH.

Complete component from one sheet metal

Flexibly rolled boards have different material thicknesses in different segments. These boards are used in the area of hot forming or press hardening. Hot forming is currently the technology that plays a central role in the topic of lightweight automotive construction. This permits a considerable weight reduction with certain vehicle components and at the same time maximizing the component strength.

„The hot forming has established a highly efficient process for producing a complete component from a single, flexibly rolled sheet metal plate,“ says Witzmann.

Time-consuming and incomplete control

Despite all the advantages, processes of this kind have their own problems. If the material thicknesses specified for a sheet metal plate go beyond the permissible tolerances and if this is not noticed until production, NIO parts are produced. In the worst case, there is a tool break, but in any case delays in production planning.

Problems and risks that can't be mastered by conventional methods of quality assurance, as the quality technician from Gedia knows from experience: „In the past, we checked individual sheet-metal

plates from various delivery batches with portable instruments. Of course, we were not able to check the entire PCB for the respective correct material thicknesses, but we could only determine individual measured values from different sheet segments by sampling. This procedure was not only time-consuming, but also incomplete, since, inter alia, the transitions of different sheet thicknesses of a printed circuit board cannot be detected with the naked eye.

Efficient testing with low tolerances

Many reasons to seriously consider a genuine alternative in the form of a specific tester. Marc Witzmann indicates some necessary prerequisites for the desired solution from his specifications: „The device should allow an efficient, continuous control of individual sheet metal plates already on their arrival on the basis of a combined thickness / distance measurement.

For this purpose, the device should be capable of accommodating sheet metals with a maximum length of 2,200 mm, while the material thicknesses being tested are between 0.5 and 4mm. Common tolerated material thicknesses for rolled sheet metals and plates are $\pm 0.03 - 0.05\text{mm}$.

The solution was finally realized by a special purpose machine manufacturer according to this and other specifications.

The testing device consists of a base table for holding the sheet metal plates and various support points. Some of these platforms serve as stops.

The measuring system is mounted on the base table and can be moved manually along the entire table length. The thickness measurement must be carried out depending on the distance traveled by the measurement system. The travel distance is outputted by the system MW100405 from ipf electronic.

Flexibly selectable starting position for high-precision linear measurement

In the absolutely wear-free magnetic linear measurement system, the sensor MW100405 is moved contactlessly at a distance of 0.1 to 2mm over the magnetic tape (scale) AM000049. Due to the four-edge evaluation (ascending and descending edge trace and, 90° phase shifted, rising and descending edge trace B) of the sensor signals, a very high repeatability of $\pm 0.1\text{ mm}$ is achieved.

The initial position of the sensor above the tape, so that from the right as well as from the left side of the sheet metal plate a measurement is possible. The passing speed is not relevant for the manual procedure of the system, since it is far below the permissible maximum values.

Very accurate thickness measurement with laser light

For the thickness measurement of the sheet metal plates a master-slave-system of ipf electronic is used, to be precise the PTSI0292 as master and the PTSI0274 as slave, which are mounted oppositely on a C-shaped bracket above the test table. At the same time, this bracket also holds the MW100405 sensor. The master-slave systems from ipf electronic consist of two mechanically identical laser distance sensors with a measuring range of 4mm (measuring range start 35mm, measuring range limit 39mm). In the specify application at Gedia, the master PTSI0292 with analog current output (4 ... 20mA) is used. The device is also available with voltage output PTSI0273 (0 ... 10V). After the one-time software-based parameterization of the overall system, the master and slave operate autonomously as a stand-alone solution.

According to the triangulation method, the devices in each case determine the distance from the sheet metal plate from one side indirectly via the angle of incidence of the laser light beam reflected by the sheet metal surface. The design of the distance sensors ensures that the measured values are not influenced by any possible differences in the reflectivity of the surface. The thickness or material thickness of a circuit board in the current measuring sector can be determined from the two distance information and the distance between the laser sensors.

The master-slave systems from ipf electronic have a very high resolution of 1µm, so even very thin, non-transparent materials, e.g. plastic or metal foils, can be measured.

Master provides overall information on material thickness

The central evaluation and signal processing is carried out directly within the master, which is connected to the slave via a line.

Since both the own measured values and those of the slave are available to the master, the master can determine an overall information about the thickness of a sheet metal segment and directly provide an analog signal for the continuous evaluation that is proportional to the material thickness. Marc Witzmann: „The master is connected to a host computer via its active PC interface, which is equipped with a special QS software for the analysis of the combined thickness and distance measurement. The software converts the analog signals of the master-slave system as well as the incremental TTL signals of the distance measuring system and synchronizes them to uniform output results.“

Significant results to the entire circuit board

These results are compared in the QS software with the references previously stored for a sheet metal plate. In addition to the output of the measuring results, the program also visualizes the measurement process in a graphic during a test. „Deviations from the permissible tolerances are

immediately recognizable by the meaningful results“, the quality technician explains. The actual measurement takes a maximum of one minute, then all the results of the test are ready.“

Reducing problems and risks sustainably

In view of the minimal procedure, Marc Witzmann is fully convinced by the testing device put into operation in spring 2016. Instead of a complicated, sample-like control with portable measuring instruments, a sheet metal plate of a delivery batch is now checked for the various material thicknesses within a few minutes. „If deviations from our specifications are recognizable, there is now the possibility to react immediately so that a defective delivery does not enter the production at all. Since we also have certain lead times between delivery and production, we have the time to complain about defective delivery batches, whereby we can minimize further problems in the long term, e.g. delays in production planning or production or even production losses.“

Image captures:

Fig. 1:

Since spring 2016 in use: With the test equipment, sheet metal plates are checked continuously for their material thickness.

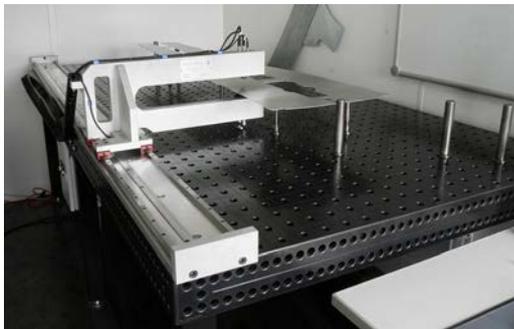


Fig. 2:

Master (top) and slave are mounted on a C-shaped metal bracket, which can be manually moved over a board. The master adopts the central signal processing and provides a continuous analog signal for the continuous evaluation of the material thickness.

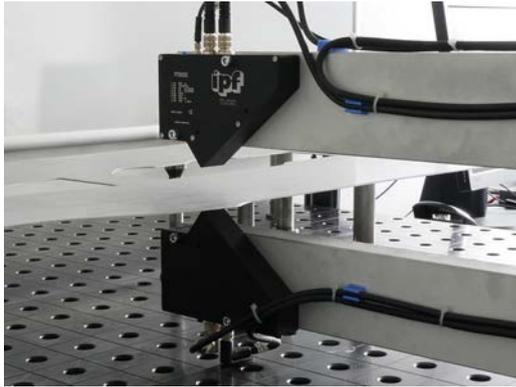


Fig. 3:

The absolutely wear-free magnetic distance measuring system consisting of the sensor MW100405 and the magnetic tape AM000049 has a working distance of 0.1 to 2mm and a repeatability of $\pm 0.1\text{mm}$.

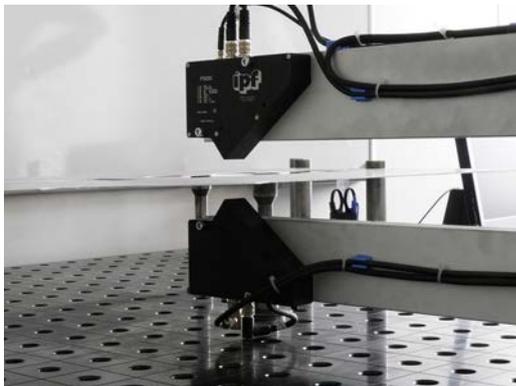


Fig. 4:

Flexibly applicable magnetic support points ensure a reliable fixing of the sheet metal plates on the base table.



Fig. 5: Marc Witzmann, quality engineer at Gedia: „Due to the meaningful results, deviations from our specifications over the entire length of the sheet metal plate are now identified in a maximum of a minute“

