Precise Industrial 3D Metrology

Sheet Metal Forming

3D Metrology in Industrial Sheet Metal Forming Processes

Production quality control
3D shape and dimension inspection
Forming limit analysis

Quality Control

in Sheet Metal Forming Processes

Growing quality requirements as well as high pressure on costs and time affect the whole sheet metal industry. In order to fulfill these demands, design engineers, tool makers as well as specialists from research & development, production, and quality control increasingly rely on optical measuring systems.

Measuring systems from GOM are used in stamping, bending, drawing, pressing, and forming process chains to guarantee consistent quality assurance: from determining the sheet metal properties, via accelerating tool try-out and first article inspection, up to series-accompanying production control and assembly analysis.

Quality control in sheet metal forming processes

For design and simulation, GOM systems provide precise material properties by determining the forming limit curve (FLC). During try-out, sheet metal parts are checked for shape and dimensional accuracy as well as for material defects: part geometry, springback, trimming, hole patterns, material thickness, and forming limit analysis. For the series-accompanying quality control, all measurement and inspection processes are automated.

Over 14,000 System Installations Worldwide

Automotive manufacturers: Audi, Benteler, Bentley, BMW, Chrysler, Daihatsu, Daimler, Fiat, Ford, General Motors, Honda, Hyundai, Jaguar Land Rover, John Deere, Lamborghini, Mitsubishi, Nissan, Opel, Porsche, Scania, Seat, Škoda, Subaru, Suzuki, Tata Motors, Toyota, Vauxhall, Volkswagen, Volvo …

Automotive suppliers: Allgaier, Bosal, Bosch, Brose, Delphi, Eberspächer, Faurecia, Gedia, Gestamp, Husqvarna, Kirchhoff Automotive, Kirchhoff Witte, Magna, Minsk Automobile Plant, Schaeffler, Suzhou Jinhong Shun Auto Parts, Tofas, Tower Automotive, TRW Automotive, Unipres, ZF …

Consumer goods: BSH Bosch Siemens Hausgeräte, Canon, Electrolux, Foxconn Electronics, Green Point Technology, HP, LG, Miele, Progress-Werk Oberkirch, Sharp …

Material manufacturers: Alcoa, Alfa Laval, ArcelorMittal, Baosteel, Han-Steel, Ilva, Nippon Steel, Novelis, Outokumpu, Salzgitter Mannesmann, Tata Steel, ThyssenKrupp, Valeo, Voestalpine ...

GOM – Precise Industrial 3D Metrology

GOM develops, produces and distributes software, machines and systems for industrial and automated 3D coordinate measuring technology and 3D testing based on latest research results and innovative technologies.

With more than 60 sites and an employee network of more than 1,000 metrology specialists, GOM guarantees professional advice as well as support and service to operators on-site in their local languages. In addition, GOM shares knowledge on processes and measurement technology in training courses, conferences and application-based workshops.

GOM has been developing measuring technology in Braunschweig since 1990. In the respective research and development departments, more than 100 engineers, mathematicians and scientists shape the measuring technology of the present and the future.

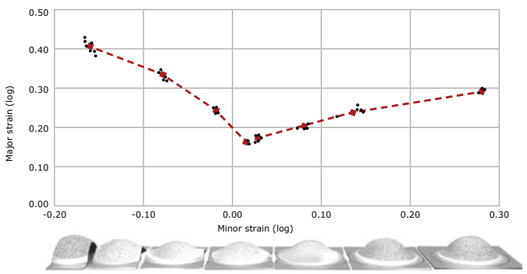
Today, more than 14,000 system installations improve product quality and accelerate product development and manufacturing processes for international companies in the automotive, aerospace and consumer goods industries, their suppliers as well as many research institutes and universities.

GOM headquarters in Braunschweig, Germany

Material Properties / FLC

Applications – Knowledge of material properties of sheet metal alloys provides a secure basis for an adequate component design (CAD), for the development of a functioning tool with good active surfaces and for a realistic simulation (CAE). This allows reliable simulation and optimization of product variants, tool lay-out and forming processes.

- Sheet metal properties and material cards
- Typical forming limit curve (FLC) of materials in accordance with ISO 12004
- Nakajima, Marciniak, Bulge in accordance with ISO 16808
- Tensile tests, hole expanding tests and shear tests



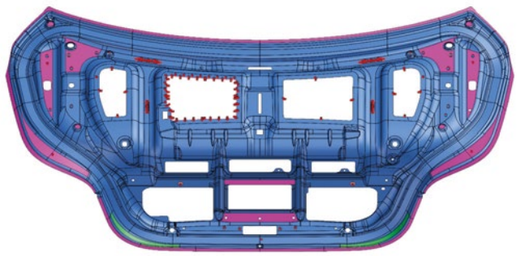
Benefit – Full-field measurements of material strain (major & minor strain) are substantially more accurate than determining by hand, magnifying glass or microscope. Reproducible determination of material properties for new alloys, incoming goods inspection and variations in quality within a coil.

Measuring systems and evaluation
ARAMIS, GOM Correlate

Design / CAD

Applications – Full-field geometry acquisition enables reverse engineering and adaption of part and tool geometries in existing CAD software packages. Furthermore, the CAD data is already supplied with inspection features during design, and 3D measurement planning occurs directly on the CAD data set.

- Acquisition of part geometries
- Acquisition of (modified) tools
- Springback compensation
- Inspection planning on CAD



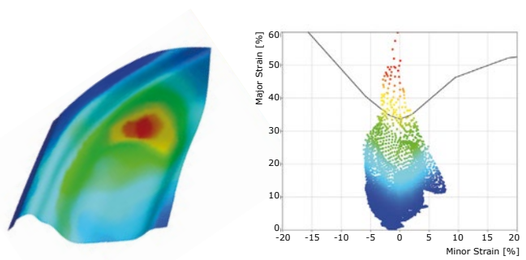
Benefit – Reverse engineering of geometric elements and freeform surfaces. Targeted springback compensation in CAD (morphing/advanced modeling). Updating CAD data after manual tool modifications. 3D measurement planning on the CAD data set prior to component production.

Measuring systems and evaluation
ATOS, GOM Inspect

Simulation & Forming Limit Analysis

Applications – Full-field 3D forming analysis reveals material defects induced by forming before they become visible to the human eye. In the forming limit diagram, measured form changes are compared to the material characteristics of the blank (forming limit curve) and critical deformation areas are detected. In addition, previously simulated geometry and strain are compared full-field and numerically with real measurements of the part.

- Material thickness reduction and material thinning (flat blanks, pipes ...)
- Major and minor strain
- Forming limit diagram
- Verification of numerical FE simulations



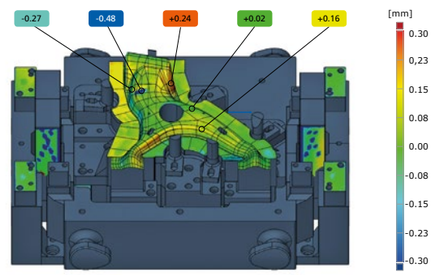
Benefit – Support for materials selection, evaluation of tools and optimization of process parameters of forming machines and forming processes. The verification of FE simulations based on measuring data serves for knowledge building and guarantees increased reliability of numerical simulations.

Measuring systems and evaluation
ARGUS, ARAMIS

Tool Making, Testing & Machine Capability Analysis

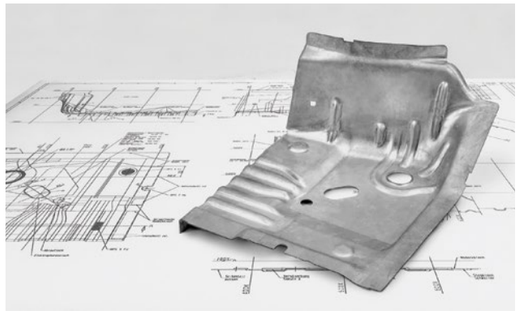
Applications – 3D digitizing provides advantages in tool making & maintenance through direct milling on STL data. In try-out, 3D measuring data lead to direct tool modifications. Measuring the dynamic forming process also provides information on stiffness, tilt, angle position, etc. of the machine tool, as the tool geometry is not always the reason for defective parts.

- CNC milling on STL measuring data
- Allowance control and positioning
- Wear control, marking of weldings, residual material detection
- Motion analysis of machines



Benefit – Reduction of CNC machining times by direct milling on STL data (tool making and maintenance). Fewer iterations before final tool buy-off. Extension of tool service life and reduction of maintenance & repair costs through precise adjustment of tool and machine tool.

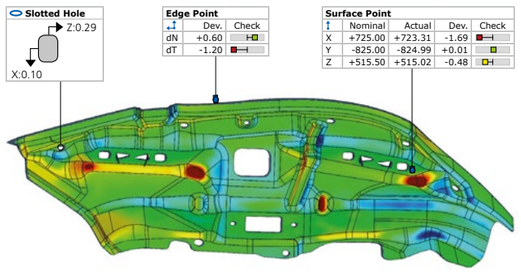
Measuring systems and evaluation
ATOS, ARAMIS



First Article Inspection

Applications – Full-field shape & dimension analyses including complete measuring and inspection reports (FAI) ensure that the functionality is secured and optical requirements are met, and allows a tension-free mounting of the component. The first article inspection is based on the measurement plan (CMM inspection), 2D drawings, or CAD with PMI parameters and Geometric Dimensioning and Tolerancing (GD&T).

- Visualization of surface defects (digital grindstone)
- Inspection of geometry & material thickness
- Springback analysis (compensation)
- Trimming & spring
- Hemmed edges, hole patterns
- Targeted tool corrections



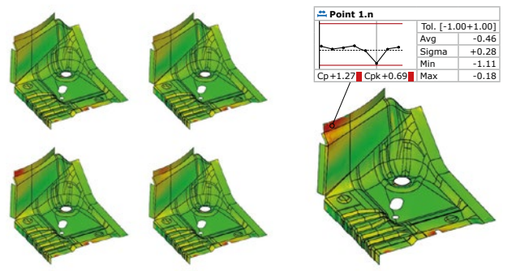
Benefit – With full-field component measurement, no spot remains unchecked. Easily understandable results instead of long tabular inspection reports enable a quick determination of correction values for tool geometry (springback, trimming) as well as for machine and process parameters (lubrication, down-holder forces, closing force ...).

Measuring systems and evaluation
ATOS, ARGUS, GOM Inspect

Series Inspection

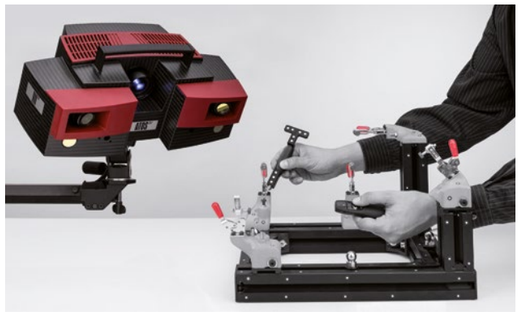
Applications – In series-accompanying production control, automated, production-related and mobile measuring cells reduce scrap and rework time. Parts do not have to be transported to remote measuring rooms. The programming, including the robot kinematics and the inspection planning, can be realized offline in the virtual measuring room (VMR) on the CAD, while the measuring cell remains productive.

- Automatic quality control
- Inspection reports at the production plant
- Trend analysis in real time (cause/progress)
- Process and wear control
- Statistical analyses and export (Cp/Cpk/Pp/Ppk/Min/Max/Avg/Sigma)



Benefit – Turnkey measuring cells are location-flexible. They can be used directly in production and deliver fast measuring results. Automated measuring cells with integrated operational safety are ready for use within one or two days. The cells are operated by shop floor workers and are adaptable for prototyping, tool making, analysis, production and assembly.

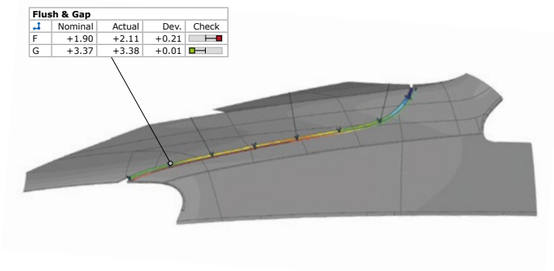
Measuring systems and evaluation
ATOS ScanBox



Assembly & Fixtures

Applications – Full-field or point-based tracking provides possibilities for alignment and positioning of physical components relative to each other (optical gauge) and allows the optimal virtual alignment to be transferred into the real physical world. In addition, using the back projection function, features such as lines, circles, and points can be projected directly onto a component.

- Calibration of fixtures, jigs, gauges ...
- Online positioning of components in nominal position or in assembly
- Gap & flush analysis
- Component marking (cutting lines, circles)



Benefit – Fast assembly analysis for prototypes, Meisterbock & Cubing as well as for series by real-time representation. Inspection of sub-assembly as well as of critical single parts (mounting geometries and component surface). Easy handling and low set-up requirements lead to the replacement of conventional gauges and fixtures.

Measuring systems and evaluation
ATOS, ARAMIS

ATOS
Industrial Optical 3D Digitizer

ATOS ScanBox
Optical 3D Coordinate Measuring Machine

ARAMIS
3D Motion and Deformation Sensor

ARGUS
Optical Forming Analysis System

GOM Inspect
Evaluation Software for 3D Measuring Data

GOM Correlate
Evaluation Software for 3D Testing

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