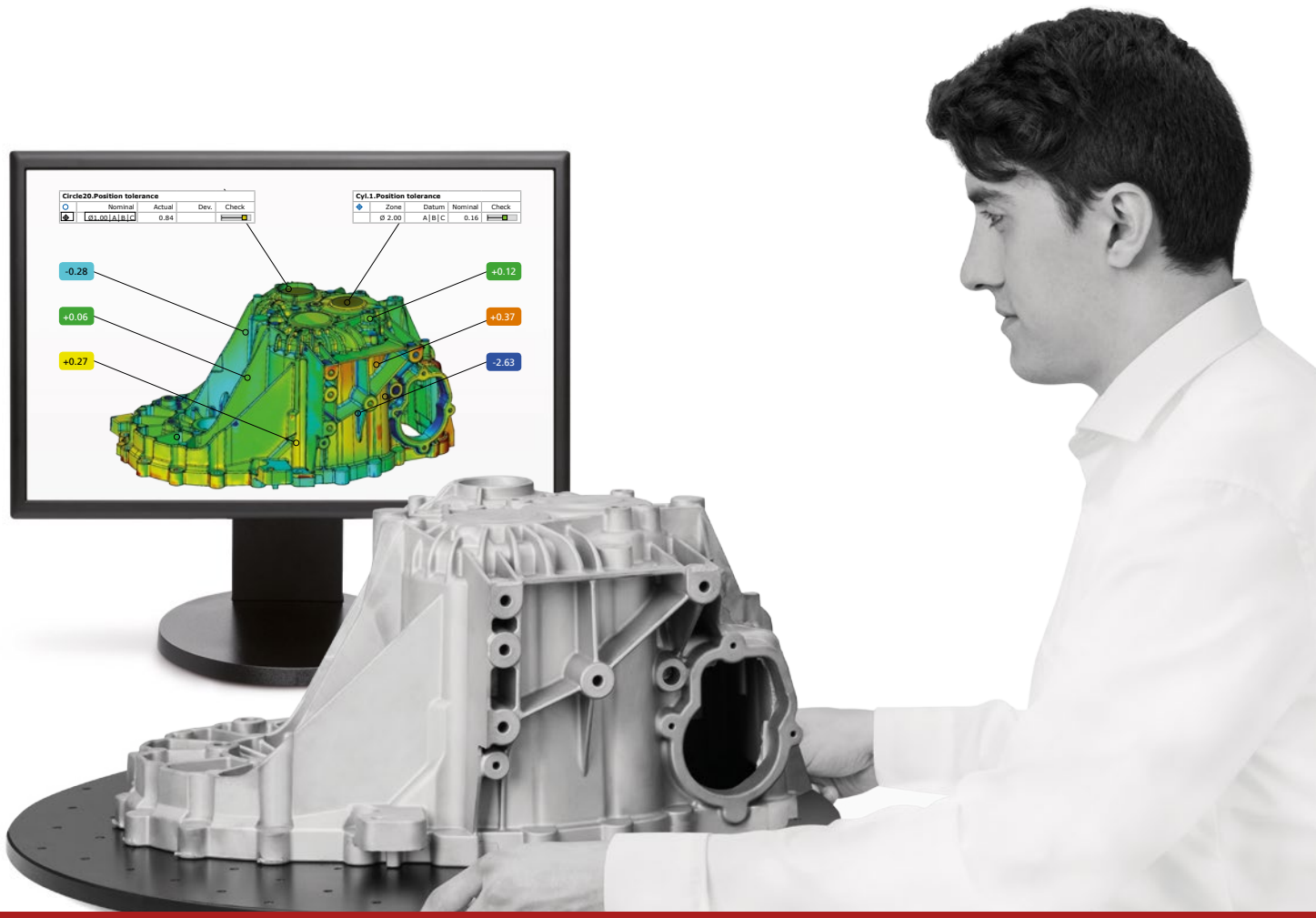
Precise Industrial 3D Metrology



Casting and Foundry

3D Metrology in Industrial Casting and Foundry Processes

Mold offset and core allowance control
Shrinkage, warpage and material thickness analysis
Part positioning for CNC machining

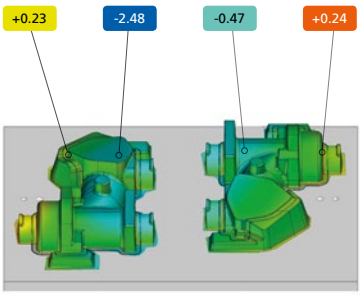
Quality Control

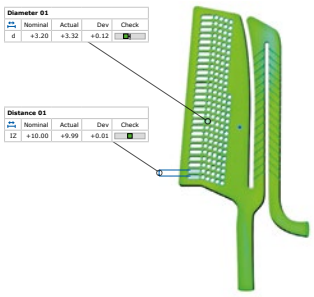
in Casting and Foundry Processes

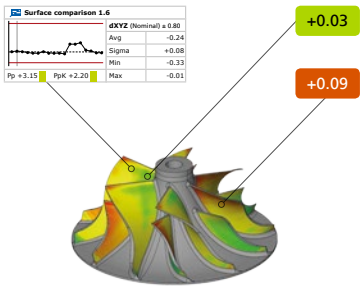
Measuring systems from GOM are used in sand, pressure die and investment casting processes to guarantee consistent quality assurance: from simulation verification, via accelerating tool try-out and first article inspection, up to production control and CNC machining.

Design/CAD | Simulation Part Distortion | Pattern and Mold Making | Molding Shop/Core Making | Foundry/Cast Parts | CNC Machining

GOM systems allow for inspection planning based on design data. In pattern and mold making, the targeted correction of tools and models and the inspection of fitting of mold halves, cores and sliders are possible. During try-out, cast parts are checked for shape and dimension: part geometry, material thickness, shrinkage and warpage. All measuring and inspection processes are automated for production quality control.







Models and Pattern Plates

- Full-field shape and dimension inspection
- Compensation of warpage and shrinkage
- Verification of milling results
- Change management and maintenance

Tools, Cores and Molds

- Targeted tool correction
- Assembly analysis
- Fitting of mold halves, core allowance and sliders
- Wear analysis

Cast Parts

- First article inspection and production quality assurance
- Shrinkage, warpage and allowance control
- Material thickness analysis
- Optimized CNC machining

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 language. 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.

Automotive manufacturers: Audi, Benteler, BMW, Chrysler, Daihatsu, Daimler, Fiat, Ford, General Motors, Honda, Jaguar Land Rover, Mazda, Nissan, Renault, Suzuki, Toyota, Volkswagen, …

Automotive suppliers: Aisin, Borgwarner, Bosch, Brembo, Continental, Exedy, Federal-Mogul, Hella, Honeywell, IHI, Komatsu, Magna, Mann+Hummel, Montupet, Nemak, Schaeffler, Sichuan Mianyang Haosheng, Takata, ThyssenKrupp, TRW Automotive, Umetoku, Voestalpine, Wuxi Ruichang Precision Casting, ZF, …

Aerospace: AETC, Alucast, Ametec, Arconic, Atlantic Precision, Aviadvigatel, Avic, Beijing Aerospace Machinery, Bell Helicopter, Boeing, Cetim, Cirex, Consolidated Precision Products, Core-Tech, Doncasters Aerospace Castings, GE Aviation, Honeywell, IHI, Kobe, Leistritz, Mitsubishi, MTU Aero Engines, PCC Airfoils, Pratt & Whitney, Precise Cast, Rolls-Royce, Rosa Group, Safran Group, Stork, TurboCare, …

Power generation: ABB Group, Aco Gruppe, Arconic, Borgwarner, Doncasters, Doosan Power, Gazprom, GE Power, Honeywell, IHI, Kobe, Leistritz, Mahle, PCC, Rolls-Royce, Rosa Group, Siemens, Stork, …

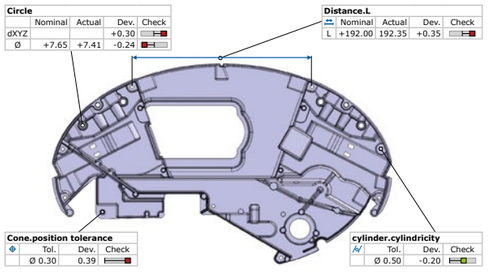
Civil engineering & transportation: Alstom, ABB Group, Bradken, Caterpillar, Claas Group, GE Transportation, John Deere, Knorr-Bremse, Kobe, Komatsu, MAN, MMG, Meritor, Mitsui Meehanite, New Holland, Nippon Chutetsukan, Rheinmetall, Siempelkamp, …

Consumer goods: Alupress, Biomet, Blanco, Blickle, BSH Hausgeräte, Fratelli Vergnano, Fuchs, Fuji, Golden Valley, Green Point, Grundfos, Hema, Heraeus, Hettich, Hilti, Huawei, Lochinvar, Makita, Miele, Minimax, Panasonic, Saint-Gobain, Sharp, Shinko Ceramics, Stihl, Stryker, Union Sports, Velux, Wago, Young Optics, Zimmer, …

Design / CAD

Applications – If the CAD model of a part has been provided with inspection features already during design, the 3D measurement planning and inspection can be performed in a drawing-free process directly on the PMI data set (import and evaluation of FTA or MBD data). Furthermore, the full-field geometry acquisition allows refeeding and adapting component and tool geometries into existing CAD data if a tool correction is necessary (advanced CAD modeling).

- Inspection planning on CAD (PLM) for Industry 4.0
- PMI interfaces (CATIA, Creo Parametric, NX)
- Importable tolerance tables
- Camber of tools, incorporation into CAD



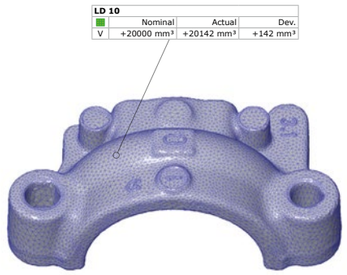
Benefits – The direct import and evaluation of PMI data including tolerance specifications from 3D design models, accelerates new product development processes and production processes by 3D measurement planning on the CAD data set or via FTA or MBD data prior to component production. Digital inspection data ensure a continuous control throughout the complete PLM (Industry 4.0).

Measuring systems and evaluation
ATOS, GOM Inspect

Simulation / Verification

Applications – Simulation serves to compute and visualize the mold filling, sprue, holding pressure, temperature control and filling time of the cast part. The purpose is to prevent errors and to optimize the use of materials, the cycle time and the machine size by prognosticating the material behavior and process parameters. The complete surface of the simulated geometry is numerically compared to the simulated or real component measurements.

- Processing of mesh simulation data
- Mesh processing (refining, hole filling, repair, ...)
- Comparison of simulated and real components
- Verification of casting simulations



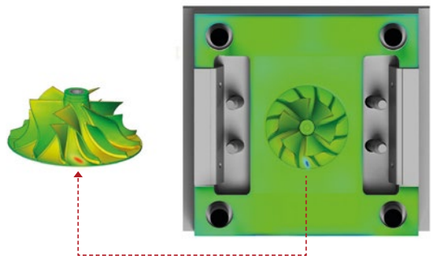
Benefits – Support in the evaluation of tools and optimization of process parameters. The verification of FE simulations serves for knowledge building and guarantees increased reliability of numerical simulations. The trend analysis based on simulated parameters ensures reliability when making decisions for the further process (finding best mesh).

Measuring systems and evaluation
ATOS, GOM Inspect

Toolmaking

Applications – 3D digitizing saves time and costs during toolmaking and maintenance. Controlling the individual manufacturing steps at an early stage during CNC machining of pressure die-cast tools and electrodes, wax pattern and ceramic core dies as well as sand core boxes via nominal/actual comparison, reduces iteration loops, especially for multiple cavities. In try-out, targeted tool corrections are based on 3D measuring data.

- Targeted tool correction
- Faster tool buy-off
- Maintenance & repair
- Marking of applied material and repair welding



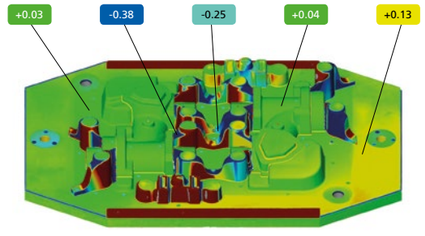
Benefits – Improved planning of repairs by determining life-time and tool service life. Machining areas on components, which demand welding or rework by metal cutting, are marked by back projection of isolines from nominal/actual comparison. Safe archiving of later tool corrections.

Measuring systems and evaluation
ATOS, GOM Inspect

Pattern Making

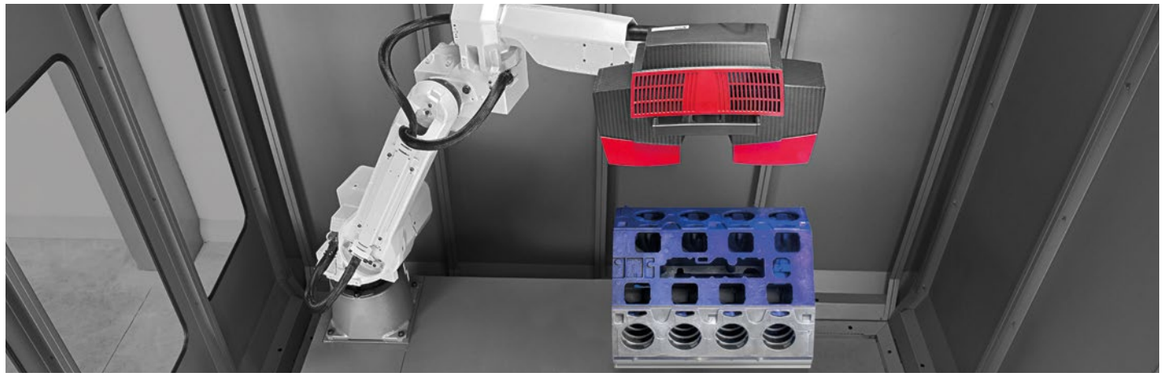
Applications – The systematic shape and dimension control of wax and foam patterns, wax assemblies, pattern plates and equipment ensures and accelerates the subsequent process steps in mold production and casting and foundry processes. By controlling the milling results at an early stage, possible errors in pattern plates and pattern equipment can be identified and eliminated.

- Verification of milling results
- Geometric validation of models
- Inspection of warp and shrinkage (local/global)
- Camber of models, incorporation into CAD



Benefits – Inspection of wax patterns regarding shrinkage, rips and blisters for targeted mold modifications and wax assembly control. 3D measuring data of foam patterns, pattern plates and pattern equipment show milling errors including improperly milled radii and serve as data backup of approved pattern plates.

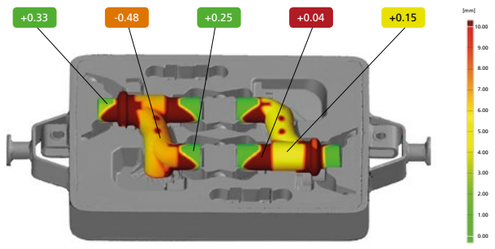
Measuring systems and evaluation
ATOS, GOM Inspect



Mold Making / Core Making

Applications – Ensuring the process quality via accompanying measurements of molds and cores, for example made of sand or ceramics. The virtual assembly analysis of mold halves and cores serves for the inspection of parting surfaces regarding offset, fitting and form fit of mold halves and core clearance. In investment casting, the creation of the wall thickness of the ceramic mold can be inspected and the quality in terms of wall thickness and formation of burrs can be estimated.

- Fitting of mold halves
- Analysis of core allowance and core prints
- Virtual assembly/die spotting
- Inspection of molds and cores



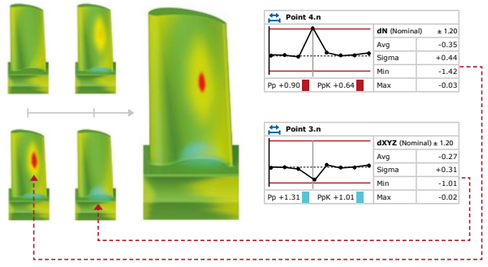
Benefits – Less rework due to improved part quality. Securing wall thickness & cooling structures, e.g. water cooling jackets and cooling ducts. 3D measuring data provide information for the root cause analysis to avoid defects and cracks in ceramic cores during wax molding. The check of cores and sand molds serves for the wear control and analysis of pattern plates and tools.

Measuring systems and evaluation
ATOS, ARAMIS, PONTOS Live

First Article Inspection / Series Inspection

Applications – The first article inspection can be carried out based on the inspection plan (CMM inspection), CAD model or PMI data set with features such as GD&T. No area of the component remains unchecked. In series-accompanying manufacturing control, automated, production-related and mobile measuring cells reduce scrap and rework time. Parts do not have to be transported to remote measuring rooms.

- Control of warpage, shrinkage, wall thickness, sink marks
- Automated quality control and inspection reports
- Geometric Dimensioning and Tolerancing (GD&T)
- Statistical trend analysis, cause/progress: Cp/Cpk/Pp ...



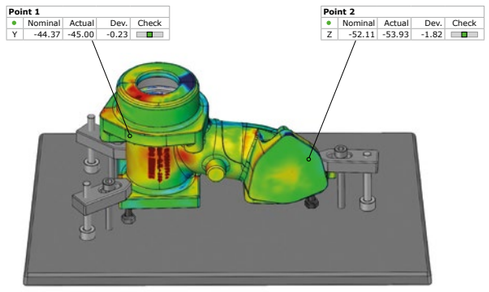
Benefits – Easily understandable results instead of long tabular inspection reports enable a quick determination of corrective values. Turn-key measuring cells are location-flexible. They can be used directly in production and deliver fast measuring results. Automated measuring cells with integrated operational safety are ready for use within one or two days and are operated by shop floor workers.

Measuring systems and evaluation
ATOS, ATOS ScanBox

CNC Machining / Optical Marking

Applications – For the back-projection function, the 3D sensor projects features, such as isolines and punch marks, straight from the software onto the real part. As a result, the conventional marking of heavy cast blanks is no longer needed. Efficient part alignment for CNC machining. In addition, 3D measuring data provide the basis for adaptive manufacturing processes (adaptive machining).

- Part positioning for CNC machining (Live tracking)
- Projection of isolines & punch marks (optical marking)
- Allowance control & adaptive machining



Benefits – Real-time measurement of part position by full-field or point-based tracking for precise alignment on CNC machine tools or pallets. Measuring the actual geometry of the blank ensures sufficient allowance in production and replaces traditional marking. The milling path is optimized based on the created measuring data.

Measuring systems and evaluation
ATOS, ARAMIS, PONTOS Live

3D Metrology

ATOS
Industrial optical 3D digitizer

ATOS ScanBox
Optical 3D coordinate measuring machine

ARAMIS
3D motion and deformation sensor

PONTOS Live
Live tracking system

GOM Inspect
Evaluation software for 3D measuring data

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