Specialities in the prototype castings production: optical measurement and patternless mold manufacturing (sand casting)
About me

Company overview (short)

Production processes (short):
- Patternless mold manufacturing
- Geometric-optical measurement

Examples (optional)
About me

Born: 09.09.1970 (48 years)
in Freiberg (Saxony)

Residence: Marienberg (Saxony)

Family: Married, 2 children
(m 10 years, f 16 years)

Education: Degree in Business Administration
at Technical University in Chemnitz

Job: Sales Engineer at ACTech
since August 2001

Contact:
Phone: +49 3731 169 107
Fax: +49 3731 169 500
Mobile: +49 162 2954 602
E-mail: tgo@actech.de
About me

Company overview (short)

Production processes (short):
- Patternless mold manufacturing
- Geometric-optical measurement

Examples (optional)
Company | Overview

Foundation: 1995
Personnel: approx. 375
Production area: 8,500 m² (92,000 sq ft)
Capacity: approx. 10,000 prototypes per year
Turnover 2017: 35 Mio. Euro

QM and EM certifications according to:
“Specialities in the prototype castings production”
AMAP Kolloquium | 11.01.2018 | Aachen
ACTech GmbH | Thomas Gotte
Company | Plant

Sand casting foundry
- Management, administration
- Mold manufacturing
- Mold assembly
- Foundry shop
- Heat treatment
- Quality control

4,500 m² (48,000 sq ft) shop floor
Company | Plant

CNC shop
• State of the art and extremely flexible

2,000 m² (21,500 sq ft) shop floor
Company | Plant

**Investment casting foundry**
- Pattern manufacturing with rapid prototyping
- Mold manufacturing plaster and ceramic

2,000 m² (21,500) sq ft shop floor
Company | Locations

ACTech GmbH
Freiberg | GERMANY
headquarter | manufacturing
375 employees
all facilities in house

ACTech North America Inc.
Ann Arbor, MI | USA
Sales Office America
9 employees

ACTech GmbH Liaison Office
Bangalore | INDIA
Representation Office Asia
4 employees
Company | Member of the Materialise company

Since October 2017 (from financial investor to strategic investor)

No changes in ACTech’s business model!!!

Materialise with 27 years of experience in 3D metal/plastics printing and belonging software solutions

Company | Member of the Materialise company

October 04, 2017

Materialise Acquires ACTech, Full-Service Manufacturer of Complex Metal Parts

Acquisition will enhance Materialise’s ability to offer complete manufacturing solutions for unique 3D-printed metal parts.

Leuven, Belgium – October 4, 2017. Materialise (NASDAQ:MTLS), has today announced the acquisition of ACTech, a Germany-based leader in producing limited runs of highly complex cast metal parts. The transaction brings together the metal competencies of Materialise, a leading provider of additive manufacturing solutions and software, with those of ACTech into a comprehensive metal manufacturing offering.

ACTech has over 20 years of deep knowledge and experience in the production, treatment and quality control of complex metal parts. The acquisition of ACTech’s expertise and in-house infrastructure will enable Materialise to accelerate the development of its existing metal competence center and take a strong position in the market for the production and delivery of unique, complex 3D-printed metal parts.

“ACTech knows metal and how to shape it to production standard, and we know Metal 3D Printing. Bringing those two competencies together is vital to the delivery of high added-value metal 3D-printed parts for specialized applications.”

—Wilfried Vancraen, founder and CEO of Materialise

Source:
www.materialise.com
Press release from October 4th, 2017
**Company**  |  Member of the Materialise company

Since October 2017 (from financial investor to strategic investor)

No changes in ACTech’s business model!!!

Materialise with 27 years of experience in 3D metal/plastics printing and belonging software solutions

More information: see press releases on [www.materialise.com](http://www.materialise.com) and [www.actech.de](http://www.actech.de)

**Actual challenge:**  Find out synergy effects in both business models

Materialise:  Metal printing in Bremen

ACTech:  Metal casting in Freiberg
Scope of Business

Manufacturing of prototype castings

- Extremely fast lead time
- Complex parts
- Low quantities
- Close-to-production characteristics
- CNC machining of parts ready to be installed
Your advantage

Shortest lead time
• Time optimized planning
• State of the art production technologies

Dependability
• Complete manufacturing processes under one roof

Quality standard
• Experience of approx. 25,000 projects

Planning security
• LIVE project status available online 24/7
No risk strategy

- Response to enquiries within 24 hours including a binding quote and the shortest possible delivery time
- In-house project management, mold design, mold production, foundry, CNC machining and testings
- Data security audited by our customers
- Certified in-house quality assurance and inspection
- Punctual delivery of ready-to-install prototypes
Facts and Figures

More than 25,000 different casting designs.
More than 190,000 castings total.
More than 1,200 customers in 36 countries.
Annual capacity: more than 10,000 prototype castings.
Structure of sales volume | location of our customers

- Germany: 39%
- Europe: 31%
- North America: 27%
- Asia: 2%
- Other: 1%
Structure of sales volume | business area of our customers

Automotive 81%
- OEM
- automotive supplier
- automotive engineering

Non-Automotive 19%
- turbines, pumps, hydraulics
- industry
- aerospace
- military
- others
Structure of projects | number of castings per order

- 1 part 29%
- 2 parts 22%
- 3-5 parts 25%
- More than 50 parts 2%
- 11-50 parts 10%
- 6-10 parts 12%
Structure of projects | material of castings

Iron 39%
Aluminium 39%
Other 2%
Steel 20%
About me

Company overview (short)

Production processes (short)
  - Patternless mold manufacturing
  - Geometric-optical measurement

Examples (optional)
High speed workflow
Requirements

To choose the right casting technology we need the following information:

• Quantity of parts
• Material specifications
• Necessary tests
• CNC machining requirements
• Desired delivery schedule
Mold design | Simulation

- CATIA, ProE, Siemens NX, GeoMagic, 3Devolution, Creo, Magics
- Mold design depending on customers requirements, quantity and used rapid prototyping technologies
- Raw part design, adding machining allowance, design of the prepared feeding and gating system
- Define the split lines for mold segmentation and necessary cores, cores fitted with core prints for mold assembly
- Mold segments and cores are fitted with interlocks
- Mold filling and solidification simulation (PROCast)
- Prediction of possible casting defects
- Optimization of casting technology
Mold manufacturing

SAND CASTING

- Laser sintering
- Direct Mold Milling®
- 3D furan-resin printing
- 3D phenolic-resin printing

INVESTMENT CASTING

- Ceramic Shell Process
- Plaster Mold Process
About me

Company overview (short)

Production processes (short)
  - Patternless mold manufacturing
  - Geometric-optical measurement

Examples (optional)
RP in use

1995
Start of laser sintering - 1st machine
Mold manufacturing | Sand Casting

Laser sintering of sand cores and molds [1 of 2]

• 1st important process for tool-free casting production
• Layerwise process of cores and mold segments
• Complex filigree core packages with least tolerances in one piece
• Undercuts easy to produce
• No draft angles and fillets are necessary
• Layer approx. 0.2 mm
• Build volume: 720 x 360 x 360 mm
• Running double laser systems
Laser sintering of sand cores and molds

- 1st important process for tool-free casting production
- Layerwise process of cores and mold segments
- Complex filigree core packages with least tolerances in one piece
- Undercuts easy to produce
- No draft angles and fillets are necessary
- Layer approx. 0.2 mm
- Build volume: 720 x 360 x 360 mm
- Running double laser systems
Mold manufacturing | Sand Casting

Laser sintering of sand cores and molds [2 of 2]

- All standard sand casting alloys can be poured
- Core-in-core solutions are possible
- Low productivity because of point-based laser power
- Manual finish and post-processing necessary
- High binder content (approx. 5.5 %)
- 20 % of final strength during laser sintering process – high strength jump after post-hardening process (special knowhow in support technology and post-processing)
- High strengths with more than 1,000 N/cm²
RP in use

1995
Start of laser sintering - 1st machine

1999
Start of Direct Mold Milling® - 1st machine
Mold manufacturing | Sand Casting

DIRECT MOLD MILLING® [1 of 2]

- Mold segments up to 2,400 x 1,400 x 800 mm
- Larger molds are possible by segmentation
- No draft angles and fillets are necessary
- All standard sand casting alloys can be poured
- Production of undercuts is limited but no problem in combination with cores and mold segments produced with other RP technologies
- Processibility of all usual molding material systems
- Very large molds are available within a few hours
Mold manufacturing | Sand Casting

DIRECT MOLD MILLING® [2 of 2]

- Highest variance in the molding material systems
- No directionality (anisotropy) of the characteristics in the molding material
- No expensive finish of adherent sand deposits
- Surface quality primary depends on grain size of the mold base material - this will not be cut but teared out of bond
- Simple application of usual foundry handling systems (molding boxes, reinforcements etc.)
Historische Entwicklung der Gießerei

**RP in use**

1995
Start of laser sintering - 1st machine

1999
Start of Direct Mold Milling® - 1st machine

2016
Start of 3D sand printing - 1st machine
Mold manufacturing | Sand Casting

3D PRINTING

- Highest flexibility similar to the laser sintering process but much larger build volumes
- Layer approx. 0.25 to 0.30 mm usually
- Higher productivity because of line-based printheads and wider printheads (ready for small series)
- 80% of final strength during printing process – simple post-processing
- For fragile cores and mold segments furan-resin based system is not sufficient – phenolic-resin process necessary
- Available molding material systems for printing increase (furan-resin based, phenolic-resin based, inorganics in combination with different mold base materials)
Mold manufacturing | Sand Casting

3D FURAN-RESIN PRINTING

- Build volume: 1,800 x 1,000 x 700 mm
- 2-job-box-system for continuous manufacturing process
- Undercuts easy to produce
- Application: complex mold segments and voluminous cores for aluminum, iron and steel castings
- Use of inexpensive quartz sand as mold base material
Mold manufacturing | Sand Casting

3D PHENOLIC-RESIN PRINTING (CHP)

- New development by company ExOne in 2015 – ACTech is first user
- In the past: post-processing with microwaves necessary – today: no more post-processing (Cold Hardening Process)
- Build volume: 800 x 500 x 400 mm
- Undercuts easy to produce
- Application: complex cores with higher strength, core-in-core solutions for aluminum, iron and steel castings
- Today: material costs for synthetic mullite mold base material approx. 25 times higher than quartz sand
Mold manufacturing | Sand Casting

Excursus strengths

Flexural strengths in N/cm²

Binder content in % by mass

- Mullit + Phenol (CLS) lasergesintert
- Quarz + Phenol (RFS) lasergesintert
- Siliziumkarbid + Phenol (SiC) lasergesintert
- PUR - Cold box geschossen
- Silikat geprintet
- Kerhalit + Furan geprintet
- Mullit + Phenol geprintet
- Quarz + Furan geprintet

Binder Gehalt in Masse %
Mold manufacturing | Sand Casting

Mold assembly for a water-cooled aluminum exhaust turbine housing – an example

- Quartz + Furan, printed
- Quartz + Phenol, sintered
- Mullite + Phenol, printed
- Quartz + Phenol, sintered
- Quartz + Furan, geprintfet
- Quartz + Furan, milled
Mold manufacturing | Sand Casting

Quality assurance | Checking molding material

- Bindergehalte wird über Glühverlust charakterisiert
- Grünfestigkeit am Biegeriegel bzw. Scheibenbiegefestigkeit „gebauter“ Prüfkörper unter Berücksichtigung der Baulage pro Baujob
- Granulometrische Kennwerte, Überkorn muss vermieden werden → Schichtfehler

ACHTUNG: neue Folie 09.01.2018
Muss noch übersetzt werden!!!
Mold manufacturing | Sand Casting

Patternless mold manufacturing – Summary  [1 of 3]

The selection of patternless core manufacturing technology is based on casting technology criteria and the quality requirements of the casting:

- **Geometry**
  - Dimensions, complexity
  - Mass-volume ratio
  - Core intensity

- **Alloy**
  - Aluminum
  - Steel, iron

- **Casting properties**
  - Mechanical properties
  - Wall thicknesses
  - Lightweight designs
Mold manufacturing | Sand Casting

Patternless mold manufacturing – Summary [2 of 3]

Within the rapid prototyping core manufacturing technologies the following factors can be influenced conditionally:

- **Strength**
  - Molding material system
  - Position inside building volume

- **Gas permeability/volume/shock**
  - Binder content
  - Mold base material
  - Gas discharge

- **Surface**
  - Mold base material
  - Position inside building volume
  - Finishing/coating activities
Mold manufacturing | Sand Casting

Patternless mold manufacturing – Summary  [3 of 3]

• For the production of individual prototype castings is one additive-generative molding process not enough. Just the combination of the different RP processes allows the diversity

• For industrialization, various technical and organizational tools are necessary, which take into account the process specifics of additive-generative manufacturing in order to achieve a stable, process-reliable production.

• Mono production allows the qualification of a single additive-generative process for mass production.
About me

Company overview (short)

**Production processes (short)**
- Patternless mold manufacturing
- Geometric-optical measurement

Examples (optional)
Mold Assembly

• Exact mold assembly with modern measuring technology for lowest tolerances
• Mold segments from the various technologies can be combined
• Coating of mold segments and cores
• Completion with foundry-specific accessories (filter, chill iron, thermal feeder)
Foundry

- Aluminum, grey iron, ductile iron, compacted graphite iron, alloyed and high alloyed steel, alloys following customers specification
- Directional solidification for better mechanical properties
- Vacuum supported pouring technology for thin wall thicknesses
- 850 kg melting capacity for aluminum
- 500 kg melting capacity for iron and steel alloys
- Core removal with shock wave technology
About me
Company overview (short)
Production processes (short)
- Patternless mold manufacturing
- Geometric-optical measurement
Examples (optional)
Raw part treatment and testing

- Geometric-optical measurement vs CAD data set
- Various heat treatment processes
- Tightness testing, crack detection, Fluoroscopy
- X-ray inspection (160 kV device, radioscopy)
- Visual inspection and endoscopy up to 2 mm diameter
- Ultrasonic thickness gauge
- Surface treatment requested by customer
Geometric Optical Measurement

5 application areas along production chain

"Specialities in the prototype castings production"
AMAP Kolloquium  |  11.01.2018  |  Aachen
ACTech GmbH  |  Thomas Gotte
Optical measurement systems used for:

- Measuring of cores and mold segments as inspection in process
  - Use of GOM

- Measuring assemblies for double-checking the actual assembly with nominal CAD assembly as well as detection of assembly distortions
  - Use of GOM & measuring arm

- Measuring of the raw castings used as:
  - Check of distortion and shrinkage allowance for internal quality inspection
  - Raw casting inspection, including customer report
  - Detection of optimal machining alignment

- Inspection of the machined parts only in lower accuracy compared to tactile CMM
GOM in use

Hardware: 8 ATOS systems, 1 TRITOP system & 3 offline stations
Software: ATOS Professional & GOM Inspect Professional

- **ATOS Triple Scan Generation II** (5 million pixels)
  - measuring volumes: 1,000 x 750 x 750 mm
  - distance measuring points: 0.413 mm
  - 560 x 420 x 420 mm
  - distance measuring points: 0.226 mm

- **ATOS Triple Scan Generation III** (8 million pixels)
  - measuring volumes: 1,000 x 750 x 750 mm
  - distance measuring points: 0.329 mm
  - 750 x 530 x 520 mm
  - distance measuring points: 0.213 mm
  - 560 x 420 x 420 mm
  - distance measuring points: 0.176 mm

- **ATOS TRITOP**
  - for big parts > 1,500 mm

- **Offline stations** for evaluations of the scans

Source: www.gom.com
GOM in use

2004
Start of dimensional checks of raw parts

2012
3rd GOM system in the mold assembly installed

2017
now 9 optical systems running in 5 departments
GOM – example for a protocol for a raw casting
GOM – example for a protocol for a raw casting
GOM – example for a protocol for a raw casting
Optical measuring systems in the rapid prototyping casting process

Using optical measuring systems for measuring and analysis throughout the steps of the Rapid Prototyping process of castings has some quantifiable advantages:

- Time and cost reduction
- Ensure short lead times
- Reduced scrap
- Improved process stability
- Increased dimensional accuracy
- Reduced machine set-up time
Agenda AMAP Kolloquium

Aachen  |  11.01.2018  |  Thomas Gotte

About me

Company overview (short)

Production processes (short)
  - Patternless mold manufacturing
  - Geometric-optical measurement

Examples (optional)
CNC Machining

- CAM programming with Tebis and TopSolid
- VERICUT machining simulation
- Alignment with live optical measurement (GOM) raw part data vs 3D CAD data
- Complete external machining setup
  - Tool presetter with online data transfer
  - Shuttle table systems
- CNC machining
  - 5 axis simultaneous technology
  - mill/turn and turn/mill technology
  - up to 1,500 mm table size available
Finished part inspection

- In-process measurement technology
- Quality testing with 3D coordinate measurement, contour and roughness measurement
- Tightness testing and assembly
- Final quality check and report
Project Management

• Lead Project Manager
  – responsible for all internal and external communication
  – coordinate work of the foundry project managers and the machining project manager
  – provide technical customer service for key accounts and special projects

• Foundry Project Manager
  – specialized in casting techniques, applications and materials
  – responsible for raw part production details

• Machining Project Manager
  – specialized in product groups, independent of markets or technology
  – responsible for manufacturing details of machining

• LIVE project tracking for customers
  – updated 4 times a day
About me

Company overview (short)

Production processes (in details):
- Patternless mold manufacturing
- Geometric-optical measurement

Examples (optional)
Cylinder head with integrated exhaust collector

- Material: EN AC-AlSi7Mg0.3
- Dimensions: 510 x 360 x 340 mm
- Delivery: 6 weeks including assembly machining
- Quantity: 2
Cylinder block

- Material: EN-GJL-250
- Dimensions: 355 x 341 x 269 mm
- Delivery: first component after 7 weeks including assembly machining and honing
- Quantity: 5
Integral turbine housing

- Material: EN-GJSA-X NiSiCr 35 5 2
- Dimensions: 110 x 103 x 65 mm
- Delivery: 3.5 weeks including machining
- Quantity: 2
Compressor housing

• Material: EN AC-AlSi8Cu3
• Dimensions: 154 x 132 x 73 mm
• Delivery: 3 weeks including machining
• Quantity: 2
Rear axle transmission

- Material: EN AC-AlSi7Mg0.3 T6
- Dimensions: 332 x 318 x 237 mm
- Delivery: 4 weeks including machining
- Quantity: 3
Intake module

- Material: EN AC-AISi8Cu3
- Dimensions: 384 x 372 x 150 mm
- Delivery: 4.5 weeks including machining
- Quantity: 2
Coolant distribution

- Material: EN AC-AlSi7Mg0.3 T6
- Dimensions: 504 x 397 x 132 mm
- Delivery: first batch after 5 weeks including machining
- Quantity: 70
Inlet case (turbines)

- Material: EN AC-AlSi7Mg0.6
- Dimensions: 520 x 520 x 350 mm
- Delivery: 5 weeks including machining
- Quantity: 1
Turbine inlet housing

- Material: EN-GJS-400
- Dimensions: 1,200 x 1,200 x 550 mm
- Delivery: 6 weeks including machining
- Quantity: 1
Compressor wheel

- Material: EN AC-AlSi8Cu3
- Dimensions: 475 x 475 x 250 mm
- Delivery: 3.5 weeks
- Quantity: 1
Main gear housing (helicopter)

- Material: EN AC-AlSi7Mg0.6 T6
- Dimensions: 1,347 x 1,065 x 544 mm
- Delivery: 7.5 weeks including machining
- Quantity: 1
Turbine housing

- Material: GX 40 CrNiSi 25 20
- Dimensions: 110 x 103 x 65 mm
- Delivery: 3.5 weeks including machining
- Quantity: 3
Turbine housing

- Material: GX 40 CrNiSi 25 20
- Dimensions: 146 x 146 x 103 mm
- Delivery: 3.5 weeks including machining
- Quantity: 1
RAPIDEST
PROTOTYPING

POSSIBILITIES UNLTD.

HIGH SPEED WORKFLOW

NO RISK STRATEGY

THE 1ST LIKE THOUSANDS

ACTech® all in
a materialise company
“Specialities in the prototype castings production”
AMAP Kolloquium | 11.01.2018 | Aachen
ACTech GmbH | Thomas Gotte

Contact

Thomas Gotte
ACTech GmbH
Halsbrücker Strasse 51
D – 09599 Freiberg (Saxony)

Phone:  +49 3731 169 107
Fax:    +49 3731 169 500
Mobile: +49 162 2954 602
E-mail: tgo@actech.de

www.actech.de

Thank you for your attention!