International Foundry Challenge – Suitable Production of thin walled Aluminum Prototype and Small Series Castings for Body in White Applications

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Company Information
Locations

Grunewald
Founded 1963
Employees 250
Production Sites 5
Locations 5

4 main Business Units
- Casting Production (diverse Industries)
- Tooling (Automotive, Aerospace, Energy, …)
- NC-Machining (diverse Industries)
- Assembly (Automotive, Aerospace, Semiconductor)

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The Grunewald Business Model is based on 4 main Business Areas. Know How Transfer and synergetic Effects create Innovations.

- Casting
- NC-Processing
- Aerospace Tooling and Assembly
- Automotive Tooling
Contents

Starting Point - Requirements
Body in White Concept

Body in White Structures contain significant portions of Castings, in order to integrate Components and to realize functional lightweight Geometries.

Daimler AG, SL-Class: Percentage of Materials
Body in White Concept

Grunewald offers Casting Capabilities for Prototypes and Small Volume Productions.

- 34 Vacuum High Pressure Die Castings
- 2 Low Pressure Die Castings

Total weight of Castings: 110kg

Daimler AG, SL-Class: Castings
Starting Point - Requirements

Series Production Design and specified Mechanical Properties are realized with Low Pressure Sand Casting + Heat Treatment.

1. High Pressure Die Casting Geometry
2. Specified Wall Thicknesses and Tolerances according to Reference Point System (RPS)
3. Mechanical Properties equivalent to Series
4. Economical and in Time Production
Contents

Integrated Casting Product and Process Development
Casting Process Development

Specification, Properties and Quality Requirements determine the Process Development.

- **Product Specifications**
  - Mechanical Properties
  - Dimensional Accuracy
  - Tolerances
  - Surface Quality

- **Material Properties**
  - Alloy
  - Mould Material
  - Black wash
  - Gating and Feeding Technology
  - Cooling

- **Quality Control**
  - Process Metallurgy
  - Crack test
  - X-Ray
  - Dimensional Metrology

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CAE - Development

The Feasibility of thermal + mechanical Properties are analysed on basis of numerical Simulation. Boundary Conditions and Process Parameter are calculated.
Process Tolerances

Process Steps, Functions, Parameters, Tolerances and Interfaces have to be developed and defined in an integrated Process Chain to achieve Quality and Cost Effectiveness.
Moulding and Casting Process

- Rapid Prototyping, Qualified Master Casting (QMC)
- Low Pressure Sand Casting
Foundry Areas

Vertical Integration leads to Reliability and Liability as well as Lead Time Reduction.
Pattern Making

Specialists with Handcrafting Know How finish and complete the 5-axis machined plastic Patterns.

Manual Finishing after NC-Processing
Mould Production

Black Washing and Coating Techniques create high Quality surfaces.

Moulding
Low Pressure Sand Casting

Low Pressure Casting Systems produce repeatable thin walled Castings.

Low Pressure Casting Technique
- Crucible Volume 2 x 300 kg, Tandem System
- Dynamic Pressure Control
- Core Block - Sand Casting
Heat Treatment

Heat Treatment Know How to achieve specified mechanical Properties.
Straightening

Specialists with Handcrafting Know How straighten the Castings.
Blasting

Modern Blasting Technology generates regular Surfaces.

Blasting Cabin
NC – Machines (examples)

5-Axis Milling Technology and NC – Specialists produce finished Parts.

NC – finished Part Processing

1.800 x 2.100 x 1.250 mm

1000 x 800 x 500 mm
Assembly

Use of Aerospace Assembly Strategies and Quality.

Assembly of e.g. Helicoils and Add-On Parts
Pre-Series Casting

Daimler AG, SL – Roof Component
Pre-Series Casting

Daimler AG, SL – C-Pillar
Prototype Casting

Body In White Component
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Competitive Factors
Know How Transfer
Carbon Fibre (CFRP) into Hybrid Car Structures

Competitiveness per Composite Know How and Capability.

Aerospace  ↔  Automotive

1. CFRP Part Design
2. Production Tooling Techniques like Lay Up Tools, RTM Tools
3. Manufacturing Processes
4. NC-Processing and Water Jet Cutting (Savings in Fettling up to 75%)
5. Assembly and Adhesive Technologies
Know How Transfer
Assembly Strategy and Technology

Competitiveness per Assembly Know How and Capability.

Aerospace  ↔  Automotive

1. DIN ISO 9100 Certification
2. Adapted Assembly Tooling Techniques
3. Process Quality Improvement
4. Qualification of Employees
Pattern and Tool Life Time

Material Properties and Costs

Tool Life Time and Productivity

Plastics Technology → Casting Patterns

Competitiveness per professional Material Selection and Processing Know How.

Material 1: 3,- € / dm³
Material 2: 6,- € / dm³
Material 3: 8,- € / dm³
Optimization of Interfaces

Competitiveness per Optimization of Interfaces.

CAD

Milling

Assembly

technical Interfaces

human Interfaces, communicative Competences

professional Education ➔ professional communicative Behavior

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Summary and Perspectives
### Components:
A-, B-, C-Pillars, Window Frames, Roof Components, Joint Components, Doors, Tail Gates, others

### Part Dimensions:
up to ca. 1500mm x 1200mm x 400mm

### Geometrical Accuracy:
+/- 0.8mm (Raw Part)

### Wall Dimensions:
> 2mm (+0.4mm/-0.2mm)

### Casting Techniques:
- Sand Casting
- Low Pressure Sand Casting
- QMC Prototype Casting on Basis of Laser sintered Rapid Prototyping Polystyrene Models or Sand printed Moulds

### Melting Capacity:
ca. 300kg – 1000kg, Prototype Volumes are possible

### Moulding Material:
Cold-Box Pep-Set

### Surface Finish:
correspondent to Moulding Material

### Surface Treatment:
Passivation, KTL, Ni-Plating, others

### Tool Life Time:
- Plastic Tools 1 – 30000 (Material dependend, incl. Maintenance)
- Metal Tools x – 100.000 (Material dependend, incl. Maintenance)

### Production Capacity:
1 - ca. 5000 Castings per Year
Cost Effectiveness

Small Volumes can be produced economically with Low Pressure Sand Casting.

Low Pressure Sand Casting (LPSC) / High Pressure Die Casting (HPDC)
Thank you for your Attention.

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