

North America 2015 9th - 11th of Nov

AUTOMOTIVE LIGHTWEIGHT

PROCUREMENT SYMPOSIUM

Cobo Center, Detroit, USA



SYMPOSIUM FOCUS

- Aluminum
- Carbon Fibre
- Composites
- High Strength Steel
- Magnesium

The 3rd Automotive Lightweight Procurement Symposium to be focused on automotive lightweighting, supply / process chain and procurement management, will take place in Detroit from the 9th – 11th of Nov 2015. The symposium is held in the days leading up to the "ALUMINUM USA" exhibition taking place at the Cobo Center, Detroit, Michigan (Walking distance to symposium venue)

ATTENDING COMPANIES:



ORGANIZING PARTNERS & SPONSORS



AluMag®
 Europe 2016 27th - 29th of Nov
 AUTOMOTIVE LIGHTWEIGHT
PROCUREMENT SYMPOSIUM
 Hilton Hotel in Duesseldorf, Germany

AluMag®
 Asia 2016 6th - 8th of July
 AUTOMOTIVE LIGHTWEIGHT
PROCUREMENT SYMPOSIUM
 Jumeirah Himalayas Hotel in Shanghai, China

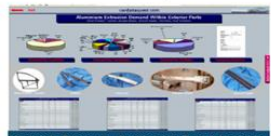
AluMag® offers the four following services - worldwide:



Market Research

- Aluminium Extrusion Customer Database
- Foundry & Tool Maker Database
- Automotive Application, Material & Process Analyses
- Various Industrial Application Research & Analyses

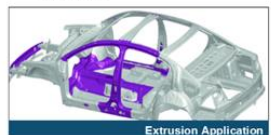
AluMag as your provider of automotive research and forecasting studies, offers you and your business, the market intelligence you need to realize the best strategic decisions



Material - Process - Application Trend Analysis

Large variety of market access, local & global:

- business database with 6,970+ companies and 18.700+ contacts
- 150+ satisfied customers worldwide
- Arranged 20+ roadshows/events since 2008



Extrusion Application

Your Benefits:

- Learn about your [potential] clients and competitors
- Obtain an inside view of the market
- Identify opportunities and threats
- Minimize risk and optimize profits
- Position your company successfully
- Based on data off the shelf, secondary re-research and interviews, AluMag generates validated researches



Market Development

- Analysis & Development of Market Opportunities
- Accelerate Market Penetration
- Manage New Product Launches
- Establish a Sales Force Sales on Demand

AluMag guides and supports your organization globally through the different market development phases until we have successfully launched, implemented or executed your project.



Map of activity - SAMPLES

Manage and integrate each aspect of your organization by initiating, planning, controlling, executing and closing out a new project. AluMag offers liaison management services as an addition to our customer's staff by bringing in the resources that define us.



JATCO Head Quarters Meeting in Japan

Your Benefits

- Analysis and development of Markets
- Realize opportunities
- Accelerate market penetration
- Establish a sales force
- Provide warehousing and distribution services
- Manage new product launches
- Sales on demand



Roadshows / Events

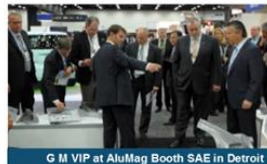
- Organization of Technical & Commercial Roadshows
- Oversea Commercial & Technical Events
- Host In-House Events & Presentation
- Common Technology Booth at Leading Exhibitions

AluMag roadshows, tech-meetings and symposia are the first class events used by exhibitors and guest as a unique benchmark platform.



Daimler Sindelfingen as Roadshow Location

The AluMag think tank events are bringing in decision makers and executives in EUROPE, ASIA and NAFTA.



G M VIP at AluMag Booth SAE in Detroit

Upcoming Events:

- 2015 Nov: Automotive Light-weight Procurement Symposium in Detroit, USA
- 2016 April Common tech- booth at the SAE World Congress in Detroit, USA
- 2016 Jul: Automotive Light-weight Procurement Symposium in Shanghai, China
- 2016 Nov: Automotive Light-weight Procurement Symposium in Duesseldorf, Germany.



Strategic Localization

- Warehousing & Distribution Service
- Supplier & Tie-up Localization
- Identification & Trade-off of new Technology
- Foreign Market Business Cases and whose Realization

AluMag has the global expertise to search, identify, evaluate and validate potential strategic business opportunities for expansions and partnerships that will assist your business growth plans regionally and globally



On-Site Greenfield Planning Meeting

Services for:

- Search, develop and present potential acquisition candidates for regional and global business expansions
- Localization of new manufacturing / service sites for business expansions
- Identification of new technology supplier development related to products, processes and materials
- Search, develop and present potential business partners / suppliers to support regional and/or global supply programs
- Evaluate potential competitor profiles for new or existing business in non-presence geographies
- Evaluate new emerging technologies and processes for business expansions

Are you:

- looking for specific data, information and outlook about product, material, customer, supplier, technologies, ...
- want to discuss your project, increase sales, access new markets, ...
- interested to participate in one of our roadshows / events or organize your customized showcase ...
- looking to localize, expand into new markets, countries, tie-up targets, ...

please contact your AluMag Team to receive a quote or proposal

CONTACTS & PROJECT TEAM



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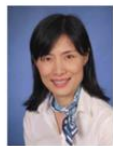
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N. America Automotive Lightweight Procurement Symposium 2015 9th – 11th Nov

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THE MARKET DEVELOPER

Company Speechs by:

Ford Research and Innovation Center

Carbon War Room and Meritor Headquarters

Striko Westofen America

Kurtz

Bharat Forge Aluminiumtechnik

C.P.C. USA

BOCAR Group

Ford Motor Company

Automotive Insight

EJOT Fastening Systems LP USA

UACJ Corp.

Lightweight Innovations for Tomorrow

Aluminum Blanking Company

Agenda

Agenda: (Is Continuously Being Updated)

Monday The 9th Of November – Cobo Center, Detroit

05:30pm - 07:30pm



Pre-registration and Welcome

Reception

Tuesday The 10th Of November – Cobo Center, Detroit

08:30am – 09:15am



Registration

Morning Coffee / Tea

09:15am – 09:30am



Welcome:

Mr. Jost GAERTNER - Managing Partner At AluMag Automotive GmbH

09:30am – 10:25am



Opening Keynote: Mr. Craig RENNEKER - Chief Engineer, New A/T Programs & Component – Transmission & Driveline Engineering At Ford Research & Innovation Center

Lightweight Transmission & Driveline Components: Practical Challenges

10:25am – 11:00am

Break for Refreshments/Coffee/Tea, Snacks, Networking, Tech Exhibition

11:00am – 11:45am



Paper 1: Mr Mike ROETH – Executive Director At North American Council for Freight Efficiency (NACFE) & Operations Leader – Carbon War Room



Paper 1: Mr. Karl MAYER – Director Product Line Management At Meritor

Lightweighting Heavy Duty Class 8 Tractors and Trailers

11:45am – 01:45pm

Break for Lunch, Refreshments, Networking, Tech Exhibition

01:45pm – 02:25pm



Paper 2: Mr Ryan BROWN – Director Of Sales At StrikoWestofen America

Analysis Of Cost Drivers When Buying Lightweight Solutions / Materials & The Elimination Of These

02:30pm – 03:10pm



Paper 3: Mr. Lothar HARTMANN – Managing Director Foundry Machines & Trimming Presses At Kurtz GmbH

Chassis & Suspension Weight Reduction By LPDC Aluminum With Hollow Cross Sections



Mr. Kevin CROY - NAFTA Sales Manager Foundry Machines & Trimming Presses At Kurtz GmbH

03:15pm – 03:45pm



Paper 4: Mr. Jörg MANTWILL – Director Sales At Bharat Forge Aluminiumtechnik GmbH & Co. KG

HCM And Aluminum Forging – Partnership To Birth Chassis Parts' Safety

03:45pm – 04:15pm

Break for Refreshments/Coffee/Tea, Snacks, Networking, Tech Exhibition

04:15pm – 04:55pm



Paper 5: Mr. Gary F. RUFF - President and Chief Executive Officer, Ruff and Associates, LLC 8/12 - Present

Advanced Counter Pressure Casting Process for Light-Weighting of Auto and Truck Chassis and Suspension Components

05:00pm – 05:55pm



Closing Keynote: Mr. Gilberto SALDIVAR – New Projects Group Manager At Bocar Group

Key Factors To Achieve Mechanical Properties In Lightweight Structural Parts

05:55pm – 06:00pm



Summary:

Mr. Roberto BOEKER – Managing Partner At AluMag Automotive LLC

Agenda

06:00pm - 08:00pm



Dinner Speech:
Mr. Richard KLEIN -
Responsibility Strategic Planning -
Business Development & German
Business At BOCAR

Wednesday The 11th Of Nov – Cobo Center, Detroit

08:15am – 08:55am



Mr. Ali JAMMOUL – Global Director
Body Exterior And Safety Engineering
At Ford

Body Lightweighting

09:00am – 09:40am



Paper 1: Dr. Gerald COLE – President
At Light Weight Strategies LLC

**Light Weighting the Automotive
Industry - The Road to 2025 CAFÉ**

09:45am – 10:25am



Paper 2: Mr. Laurence CLAUS -
President At NMI Training & Consulting
Inc. & Technical Consultant To EJOT
Fastening Systems LP USA

**EJOT Fastening Solutions Enable
Lightweight Body-in-white Assembly**

10:25am – 11:00am

Break for Refreshments/Coffee/
Tea, Snacks, Networking, Tech
Exhibition

11:00am – 11:40am



Paper 3: Dr. Akio NIIKURA - General
Manager R&D Division At UACJ Corp.

**UACJ's Global Strategy And
Approach To The Automotive
Aluminum Market**

11:45am – 12:05pm



Paper 4:
Mr. Lawrence E. BROWN – Executive
Director At Lightweight Innovations For
Tomorrow

**Lightweight Innovations For
Tomorrow!!!!**

12:10pm – 12:40pm



Closing Keynote:
Ms. Laura ANDERSON – CEO At
Aluminum Blanking Company

**The Story Behind Aluminum's
Sourcing Evolution: A North
America Perspective**

12:40pm – 12:45pm



Summary:

Mr. Jost GAERTNER, Managing
Partner At AluMag Automotive
GmbH

12:45 pm – 01:30pm



Reception Speech With Snacks &
Finger Food

Mr. Michael KOEHLER - Industry Vice
President At Reed Exhibitions USA

01:30pm – 05:30pm



Individual Or Guided Visit At The
2015 "Aluminum USA" Exhibition

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TITLE

Key Factors to achieve Mechanical Properties in Lightweight Structural Parts

ABSTRACT

Market demands in a vehicle and government emissions regulations have increased over the years. Technology is a big part of the business, when it comes to all single levels of the Automotive Industry. In order to achieve the pursuit of developing better vehicles, the components supplied by Tier companies have increased in complexity and importance, changing simple production processes into every day high complex tasks.

A well planned development phase creates the opportunity to analyze and visualize a complete picture of the project needs and requirements. The right design of tooling, state-of-the-art equipment, and collaboration with world class suppliers are fundamental to accomplish a successful and flawless start of production.

Development and Control of processes to achieve OEMs requirements are the Key factors to constant improvement, competitive costs and success in the industry.

Weight reduction is the trend and requirement.

How to guaranty the integrity and quality of the parts, is the challenge.

Key Factors to achieve Mechanical Properties in Lightweight Structural Parts



Introduction

Market demands in a vehicle and government emissions regulations have increased over the years. Technology is a big part of the business, when it comes to all single levels of the Automotive Industry. In order to achieve the pursuit of developing better vehicles, the components supplied by Tier companies have increased in complexity and importance, changing simple production processes into every day high complex tasks.

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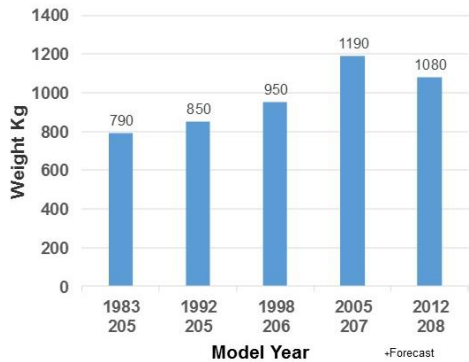
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How to guaranty the integrity and quality of the parts, is the challenge.



Weight increase over the years



Peugeot 205



Peugeot 208



"Excess weight kill any self-propelled vehicle. There are a lot of fool ideas about weight... Whenever anyone suggests to me that I might increase weight or add a part, I look into decreasing weight and eliminating a part!"
Henry Ford, 1922

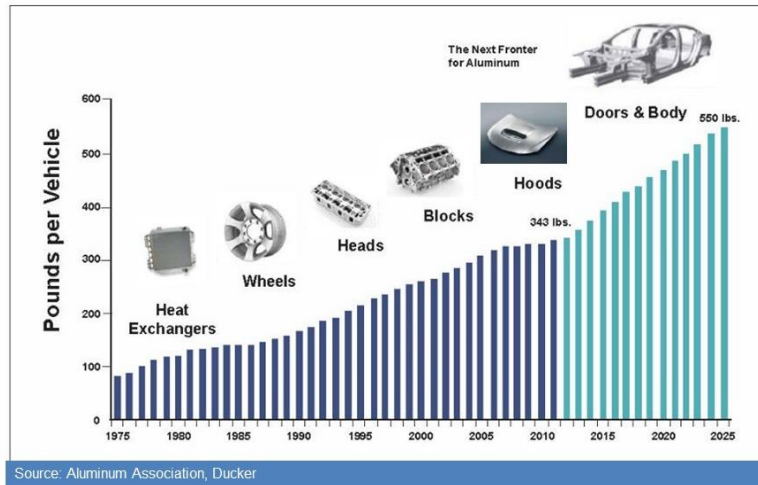
Environmental requirements

- Environmental requirements are becoming Governmental demands.
- Many countries have already clear goals, in order to reduce emissions in the following years.
- Weight plays a significant direct role in the emissions of internal combustion engines.
- Less weight, less required force, less energy used, which all end up in releasing less emissions and warm gases.



Source: Bosch

Aluminum content in automotive



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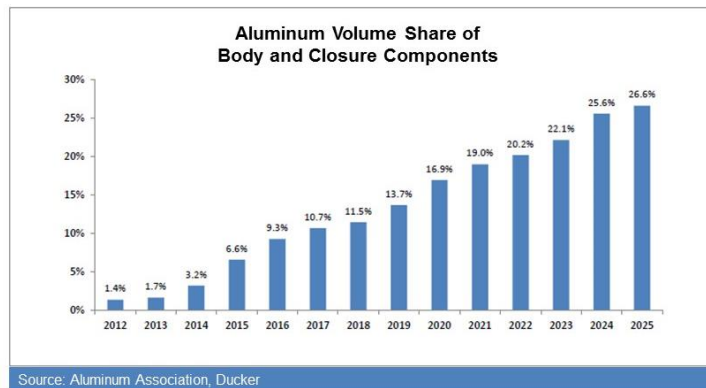
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Body and closure components share



- By 2025, 26.6% of all the body and closure parts for light vehicles in North America will be made of aluminum (measured by volume rather than weight).
- A burst of aluminum activity is expected in the few year leading up to the 2025 EPA mandate of 161 grams of CO₂ per mile taking full effect.



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Improving weight conditions



Differential - Automotive Sector

- **Material:** Iron casting
- **Weight approx.:** 51 lb

Differential - Bocar Group

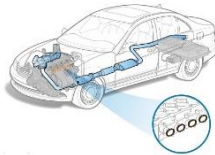
- **Material:** Aluminum A-356- T6 Treatment
- **Process:** Gravity Casting Process
- **Weight approx.:** 34 lb
- **Reduction weight:** 33% less than iron casting

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Wall thickness



Intake Manifold- Bocar Group

- **Material:** Aluminum A-332
- **Process:** Gravity Casting Process
- **Wall thickness:** 2 mm

Intake Manifold- Automotive Sector

- **Material:** A-332
- **Wall thickness:** 3.5 mm

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Different purposes



The ones we all know:

SPORTS AND HIGH END CARS:

Less weight helps to improve vehicle dynamics in a car.

ECONOMY CARS:

Weight reduction of the vehicle impacts directly to the mileage of a car.



Why in a Truck/SUV?:

LESS ASSEMBLIES:

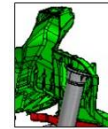
In a Shocktower, there are 7 to 10 Steel parts put into 1 aluminum part. This improves the interaction with highly automated assembly lines.

REDUCTION OF PART NUMBERS

Assembly plants will have a significant reduction of part numbers to control.

HOUSING FUNCTION

Some parts can save an extra housing or holding part in a mechanical system. (eg. Shocktowers as a housing for shock absorbers or suspension's springs) These being directly assembled to the component.



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HPDC Aluminum Structural parts



Advantages

- Weight reduction through geometric freedom
- Integration of several steel sheet parts
- Integration of suspension components
- Less emissions
- Weight reduction, better vehicle dynamics

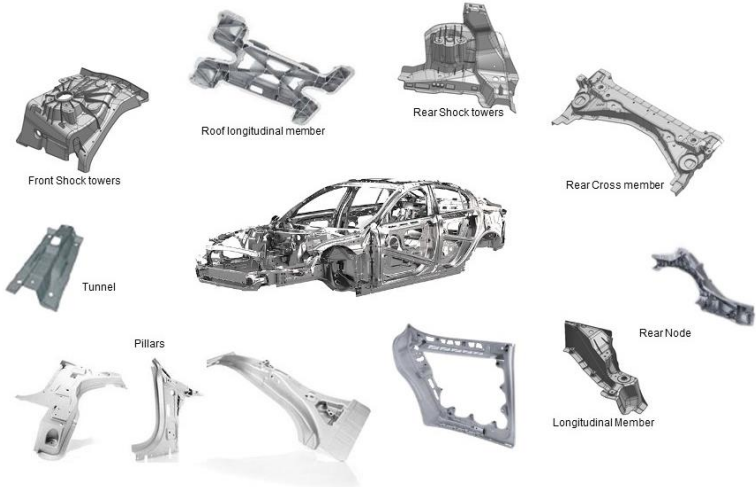


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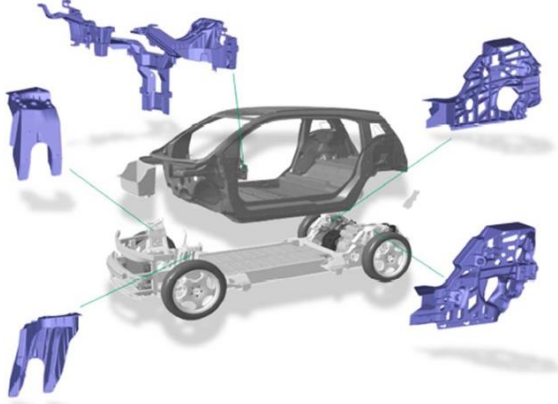
Applications of Structural parts



Structural parts integration in EV

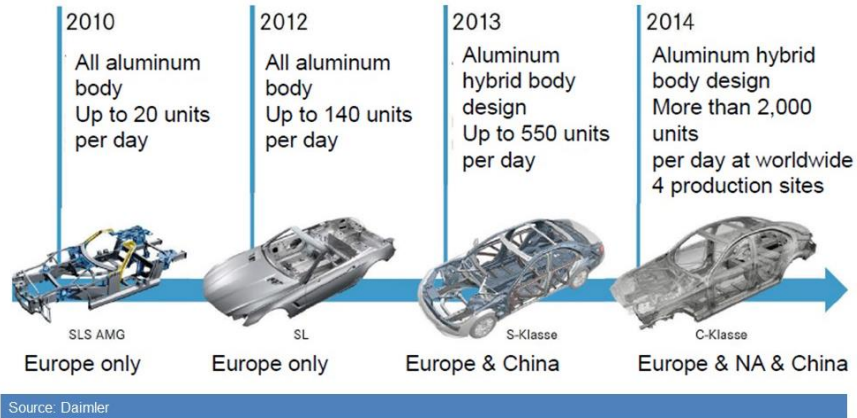


Integration of light weight material in the Electric Vehicles



Source: BMW

1 Mercedes Benz car body structures



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C-Class Structural parts




Front Shocktowers LH & RH
 Weight approx. 3.23 Kg
 Dimensions 450 x 420 x 330 mm³
 Central Ingate on a 3 Plate Die
 Shock Absorber support and suspension fixture



Rear Shocktower LH & RH
 Weight approx. 2.46 Kg
 Dimensions 530 x 295 x 410 mm³
 Integrated support for Shock Absorber



C-Class W205 Chassis



Rear Cross Member
 Weight approx. 5.20 Kg
 Dimensions 425 x 1140 x 125 mm³
 Attachment to rear cross axel and integration to the suspension fixture.



Longitudinal Member LH & RH
 Weight approx. 1.40 Kg
 Dimensions 480 x 315 x 290 mm³
 Integration to Rear Axel

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Mechanical Properties



Why are Mechanical Properties critical to achieve?



- Ductility in a structural parts (High elongation)
- High density (Low porosity)
- Collapsible characteristics, in case of a collision (Safety property)
- Structural features (Yield and UTS)
- Light and thin construction



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Structural parts characteristics



- Weight reduction (thin walls)
- Part integration
- High mechanical properties
- Crash performance
- Welded, riveted, glued, nailed, punched, clinching, etc.
- Distortion free with tight tolerances (+/- 1 mm)
- Corrosion resistance
- Pressure tightness



Source: NADCA

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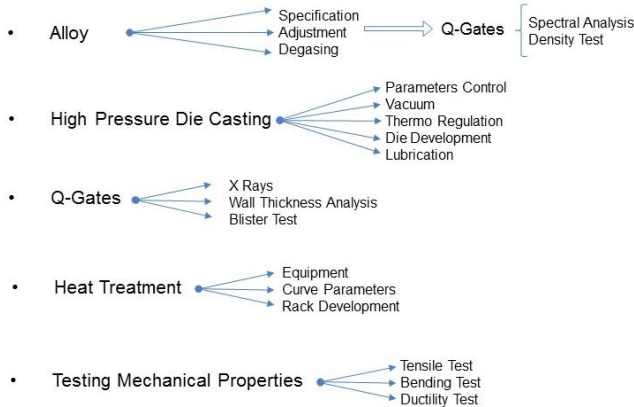
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Key Processes and Q-Gates



Key Processes and Q-Gates to achieve required mechanical properties



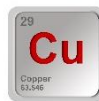
Adjusted elements and their influence



Elements commonly adjusted in the alloy:



Strength and hardness development in Heat Treatment AISi alloys



High resistance to corrosion, high strength and hardness



Helps to modify Si structure, rounding the element grain, to avoid notches and stresses.

Other elements and their impact:

Element	Effect
Si	Good HPDC feeding characteristic (fluidity), good hot tear resistance
Mn	Helps to avoid intermetallic elements and works as a released agent.
Zn	Increase resistance to corrosion
Ti	Grain structure refinement, reduce cracking tendencies
P	Low trace element

3.3 Return recycling

The diagram illustrates the aluminum recycling process. It starts with a central box labeled 'Al' (Aluminum) with atomic number 13 and symbol 'Al'. Two arrows branch out from this box: one pointing to a blue box labeled '70% max' and another to a blue box labeled '30% min'. To the right of the '70% max' box is a circular diagram showing a recycling loop with a pink arrow. Below the '70% max' box is an image of a large stack of aluminum scrap metal. Below the '30% min' box is an image of a pile of dark, granular material labeled 'eg. of intermetallics'. To the right of the '30% min' box is an image of a large industrial machine labeled 'eg. of muds and impurities'. Below this machine is an image of a person standing next to a large piece of scrap metal.

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Alloy testing and monitoring

Spectral Analysis:

1. Equipment with 22 Channels
2. Frequently tested at the Melting and Holding furnaces
 - At Melting Furnace: Every hour
 - At Holding Furnace: Every shift



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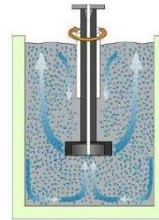
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Degassing

Degassing:

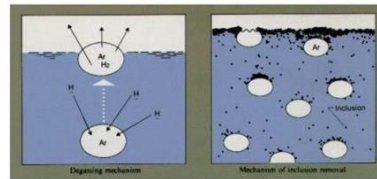
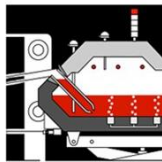
Degassing Impeller
Inert gas



Holding furnace:

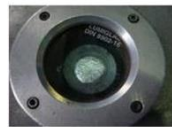
Oven with porous plug system to circulate and degas the material with an inert gas.

The porous plug will maintain the optimal density of the material.

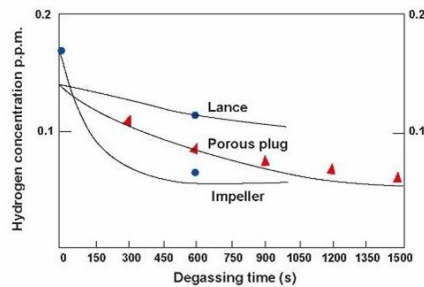


The illustration shows how the inert gas is mechanically removing air, metallic and non-metallic inclusions.

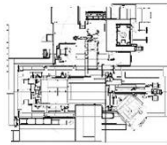
Density test



Target Value:
Density Index below 2



Die Casting and Trimming



High Pressure Die Casting Machines 1400T & 2200 T
Specific release agent
Vacuum system
Jet Cooling system
Thermoregulation system in dies
Lubrication head
Dosage furnace
Reis press



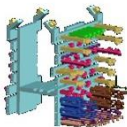
Parameters to monitor
 Cycle time
 Dosage temperature
 Switchover
 Compaction pressure
 Biscuit thickness
 Piston velocity
 Vacuum Pressure

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Die Casting and Trimming



Spray technology:

Automated lubricating heads.

Lubricant

Wax based release agent.



Trimming press



Jet Cooling



Quenching after die casting:

Tub with spray system and thermoregulation.



Robot



Dosage Furnace

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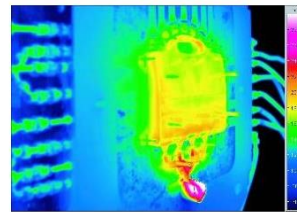
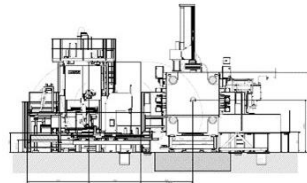
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Main features of High integrity Casting



- Optimized HPDC machine
- High vacuum system
- Complete process control
 - Critical Parameters to control:
 - Cycle time
 - Dosage temperature
 - Switchover
 - Compaction pressure
 - Biscuit thickness
 - Piston velocity
 - Vacuum Pressure
- Optimized tooling
- Die temperature control
- Proper lubricant and application
 - Release agent wax based (not oil)
- Fully automated production cell
- State of the art dosage furnace
- Thermo regulated injection sleeve
- Piston sealing



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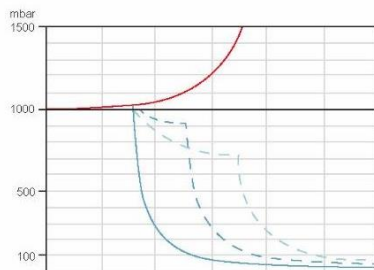
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Vacuum System



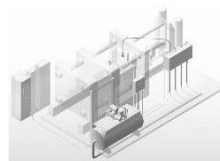
Vacuum System:

- Higher density in diecast parts
- Improved surface (ideal for a surface treatment)
- Clear reduction of porosity
- Perfect for parts with a complex geometry to be filled
- Heat treatable
- Essential for weldable parts
- Helps to reduce scrap
- Vacuum system makes possible to achieve a stable, efficient and profitable production.



Change of air pressure in cavity of the mold during casting process

- Standard evacuation (without vacuum)
- Standard evacuation
- - - regulated vacuum example A
- · - regulated vacuum example B

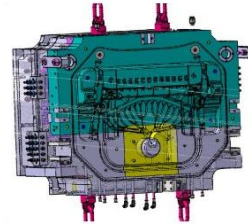
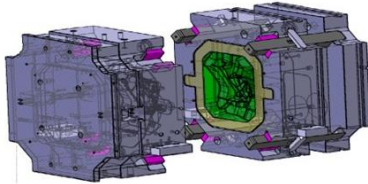


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Die development



- 3 Plate die concepts.
- Central ingate to achieve a homogenous and complete filling.
- Smaller machine size/tonnage needed.
- Design development in conjunction with tool supplier.
- Development and manufacturing proposals.

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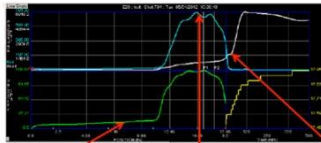
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HPDC Process control



- Successful high vacuum die cast process requires advanced process controls and monitoring systems.
- Shot control
 - Smooth metal flow & flexibility of adjustments (slow shot & low impact to eliminate flash and avoid premature wear of the die)
 - Velocity of injection is crucial to avoid micro porosity problems, which directly affects mechanical properties.
- Vacuum Monitoring/Control system
 - Apply vacuum during fast shot – repeatability is key
 - Detecting leaks or blockages is crucial
 - Monitoring system can be used to quickly troubleshoot equipment

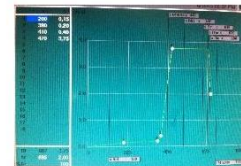


Ramp (Slow Shot)
Speed Control to control turbulence in the shot sleeve

Power to control shock waves from dynamic forces

Quick response required for intensification of thin Wall castings

Source: NADCA



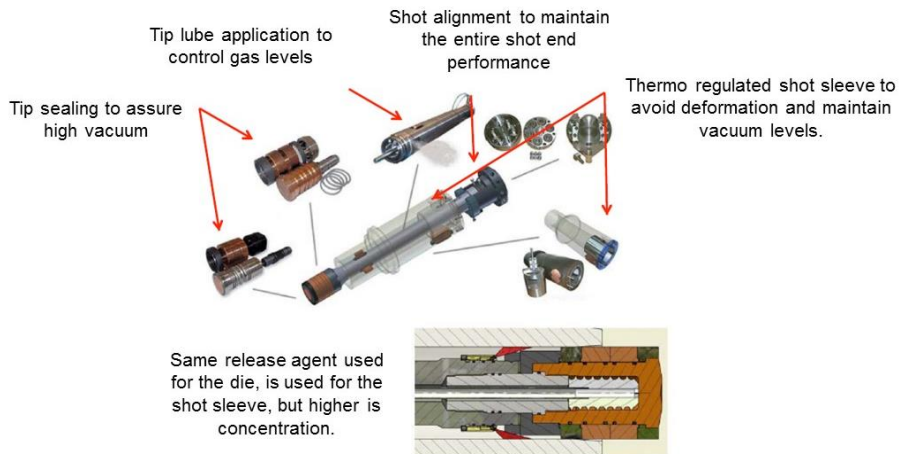
Distance Vs Velocity

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Shot end components and lubrication



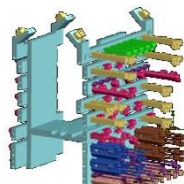
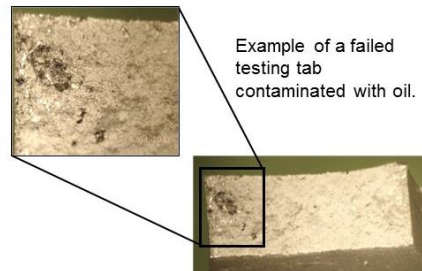
Source: NADCA

Shot end components and lubrication



Release agent for Casting:

- Separating film between die and metal melt.
- Uniform wetting of the mold surface.
- Lubricate the ejectors.
- Reducing the friction during the ejection.
- Thermal control of tooling.
- Corrosion protection of the die.
- Must be wax based lubricant in order to avoid negative effect in the mechanical properties.



Lubrication head

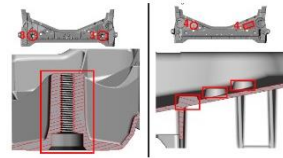
X-Ray control



Detailed and specific x-rays check plan.
Specifications according to Control Plan and Client requirements.

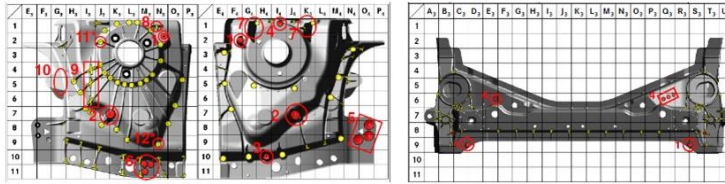
Fig. 3: Clusted porosity, spongy microstructure

Example:



Max. Size of individual imperfection: 50 mm² / 8mm diameter
Max. Cumulative imperfections: 10% per 500mm², t.e. 50 mm² imperfections per 500mm²

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Blister test



BLISTER TEST



Quick blister test at min. 520° C and for at least 45 minutes with subsequent visual inspection by operator with the naked eye.

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Blisters	Joining and contact surfaces	Blisters shall not be higher than the general Surface defects, in addition, the following rules apply: - Diameter 1,0mm - Number in case of fewer than 10 blisters with diameter 1,0 to 5,0 on joining surfaces, rework in accordance with Section 6.2 is acceptable
	All	Maximum height: 1,5 mm

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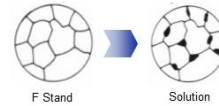
Stages of a 2-Step Heat Treat process



Solution

1.Solution:The solution heat treatment process involves heating the material to an elevated temperature (above the solvus, the closest to the eutectic phase) and soaking at this temperature for sufficient time.

A globalization comes in, and all material redistribute homogeneously, creating a supersaturated structure.

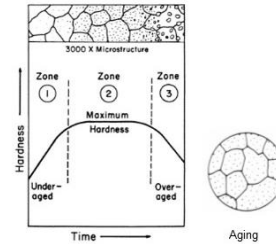


Quenching

2.Quenching:Once achieved the right and desired supersaturated structure, the material must be rapidly cooled at low temperature, in order to maintain the mentioned properties.

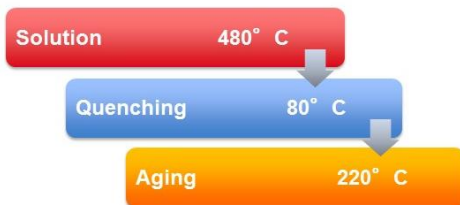
Aging

3.Aging: It is in the Aging process, where the precipitates appears and grow. The correct mechanical properties are achieved reinforcing/hardening the structure.



Source: American Society for Metals

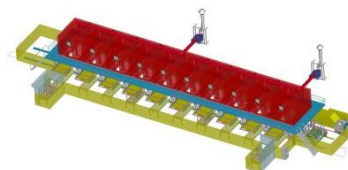
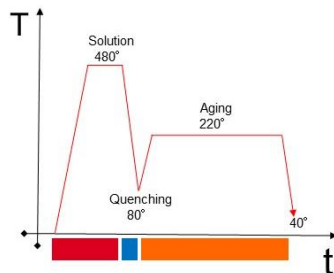
Average Curve parameters



aprox. 1 hour

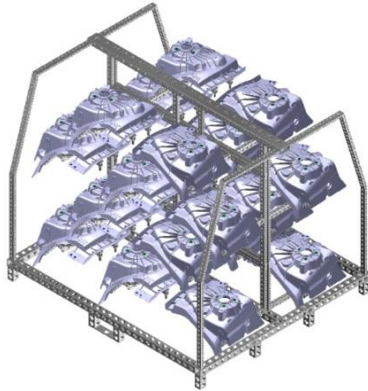
aprox. 5 Minutes

aprox. 2 hours



Heat Treatment Furnace

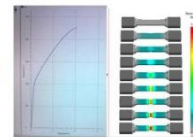
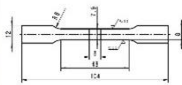
Rack development



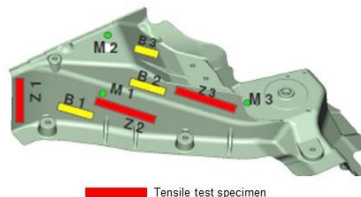
MB C-Class Shock tower



Tensile test



TEST	AA.30
0,2 Yield $R_{p0,2}$ (Mpa)	≥ 120
UTS R_m (MPa)	≥ 180
Elongation A30 (%) bzw. A5 (%)	≥ 10
Bending α° (d=2 mm)	≥ 60 (average)*



Tensile test specimen

Bending test (Mercedes Benz)

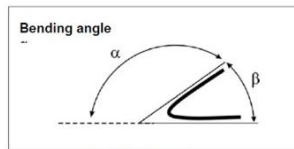
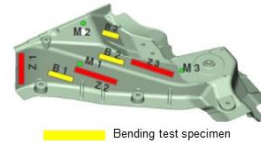
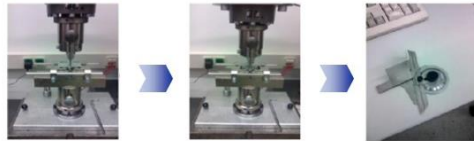


Fig. 4: Bending angle α

The standard specimen size for the bending test shall be 60 x 60 mm. If it is not possible to remove specimens of this size from the relevant castings, the specimen width can be reduced to 15 mm.

The target values for the bending angle indicated in Table 5 refer to a standard wall thickness of 2 mm. Any deviating wall thicknesses can be corrected using the following formula.

$$\alpha_2 = \alpha_1 \cdot (\sqrt{d_1}/\sqrt{2})$$

α_2 : calculated bending angle (for a wall thickness of 2 mm)
 α_1 : measured bending angle
 d_1 : wall thickness of measured specimen

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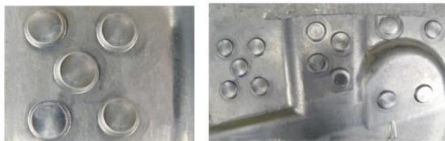
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Ductility test (BMW)



Description	Test parameter	Norm/comments
cover plate	EN AW-5182-2,5mm	GS 93013-3
tested material	casting material 2mm to 4 mm	test with cast skin
riveting	H 5,3 x 6,5 - 4	GS 96001-1
geometry of matrix	FM 1002215	Böllhof Company
final position of rivet head	rivet head overlap <0,5 mm	GS 96001-2
velocity of pincer	100-200 mm/s	
velocity of pincer	Visual inspection regarding required properties	 example: free of cracks after ductility tests



Ductility Test:

1. WS02004 once a shift at start and then once a day
2. Riveting Capability according GS 96001 at every initial sampling

Source: BMW norms





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Key Manufacturing Capabilities



<p>Porosity Specification</p>	<p>Control: X-Ray Blister Test Visual Inspection Metallography Analysis Density Analysis</p>	<p>Tool Design</p> 	<p>Jet Cooling Three plate die (Optimal metal flow) Squeeze Pins Sub-core technology Vacuum System</p>	<p>Cleaner technologies</p> <ul style="list-style-type: none"> • Wax based release agent • Porous plug Argon degassing
<p>Wall Thickness</p>	<p>Control: GOM Measurement Micrometer Tight thermoregulation control</p>	<p>Casting</p> 	<p>Key process parameters</p> <ul style="list-style-type: none"> • Cycle time • Al Dosage temperature • Switchover • Compaction pressure 	<ul style="list-style-type: none"> • Biscuit thickness • Piston velocity • Vacuum Pressure
<p>Mechanical Properties</p>	<p>Control: Universal Machine Test (UTS, Yield, % Elong, Bending Test) Spectral Analysis</p>	<p>Heat Treatment</p> 	<p>Modular Design</p> <ul style="list-style-type: none"> → State-of-the-art construction to avoid loss of temperature → High precision of temperature control → Air quenching → Curve precisely optimized 	<p>Alloy Specification</p> <ul style="list-style-type: none"> → Tight monitoring and control → Constant material adjustment
<p>Dimensional</p>	<p>Control: GOM Measurement CMM Measurement Straightening Fixtures Klopf Model Manual Gauges (Go/No-Go)</p>	<p>Straightening</p> 	<p>Straightening process</p> <ul style="list-style-type: none"> → RPS system defined with OEM → Electronic Profile Gages 	<p>Minimal part distortion:</p> <ul style="list-style-type: none"> → Air quenching → Advanced rack design

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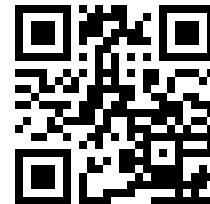
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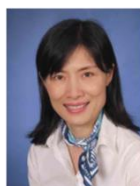


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