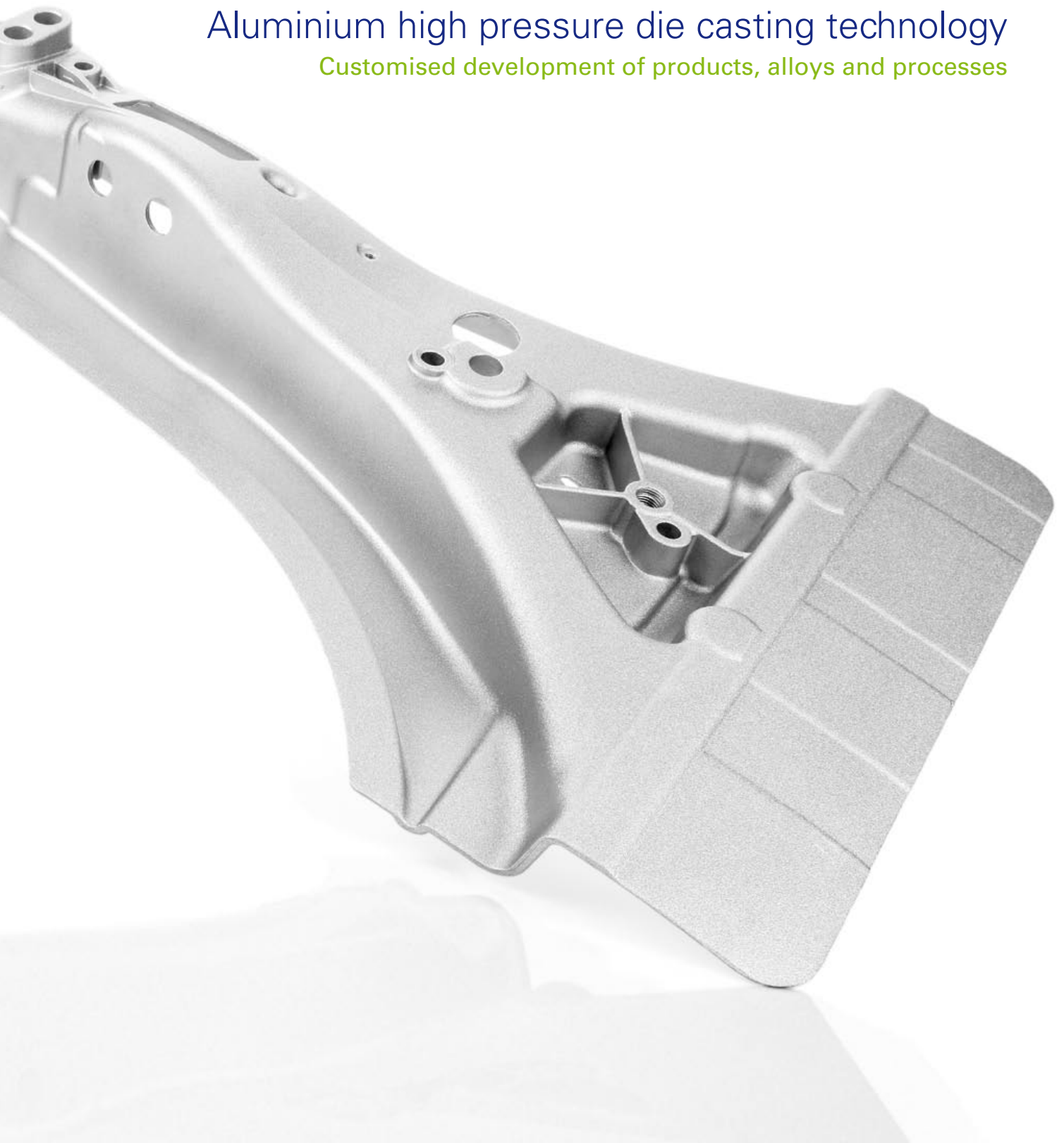


## Aluminium high pressure die casting technology

Customised development of products, alloys and processes





### BDW technologies

- is the preferred research and development partner of its customers.
- offers individual solutions and customised component features.
- guarantees a consistently high level of quality.
- can compete on a global scale, thanks to its medium-sized company structures and high level of automation.
- provides all core processes and expertise in-house.
- has a clear technological advantage over its competitors through years of experience in structural components.



B-post on the rear window frame of the AUDI A6  
AURAL-2® as cast, weldable

## A light alloy casting heavyweight

Traditional company sets highest standards.

As an owner-run, medium-sized company operating as a research and development partner for its customers, BDW technologies understands the importance of a consistently high level of quality and reliability. Flat structures and short decision making processes have made this traditional company into a modern, flexible partner to the automotive industry.

BDW technologies was the first die-caster to mass-produce large surface structural components successfully, and has since remained the undisputed leader in this sector. With its outstanding personnel, all experts in their specialist areas, the company's alloy and heat treatment expertise is unique within the industry. A large number of patents bear witness to our expertise and innovative force.

A state-of-the-art plant with a high degree of automation facilitates the production of large and small series and also enables the rapid delivery of precision cast parts, often with tailor-made component features. BDW technologies has a clear quality advantage over its competitors, undertaking all the key processes of high grade aluminium high pressure die cast products itself, and at globally competitive prices.

With experienced personnel, an open approach and a commitment to delivering on promises, BDW technologies has gained a high level of trust with customers. Our references speak for themselves.

High pressure die casting as a core area of expertise at BDW technologies has a long tradition dating back to when the company was founded in 1926. This expertise has since been developed to the extent that our company not only masters all the standard practices, it invents new ones. Innovations such as MFT technology and the derived HIGH-Q-CAST® process alongside a large number of AURAL® alloys invented in-house have been successfully patented.

The important factor is that the existing technology has been precisely adapted to our innovations and maintained at a consistently high level. For this reason an extensive internal standards department assists our suppliers in designing die casting and trimming tools to match our technology 100%. Only by using perfect casts from the onset can we avoid costly optimisation loops and ensure reliable series production.

Faced with growing requirements for the mechanical properties of cast parts, a new technology arose in conjunction with AURAL® alloy development – heat treatment. Here too our research resulted in another patent, AURALTHERM®. The Power & Free heat treatment line has been specially designed for large series and is controlled and monitored by a PLC largely adapted to the process. Specifically adapted to AURALTHERM®, it ensures a high level of reliability and saves energy. The monitoring of each and every carriage guarantees permanent traceability.

Downstream processes such as vibratory finishing, abrasive blasting, CNC processing and assembly complete the process chain. As a full service provider, BDW technologies can therefore reduce the cost of administration and logistics for its customers.

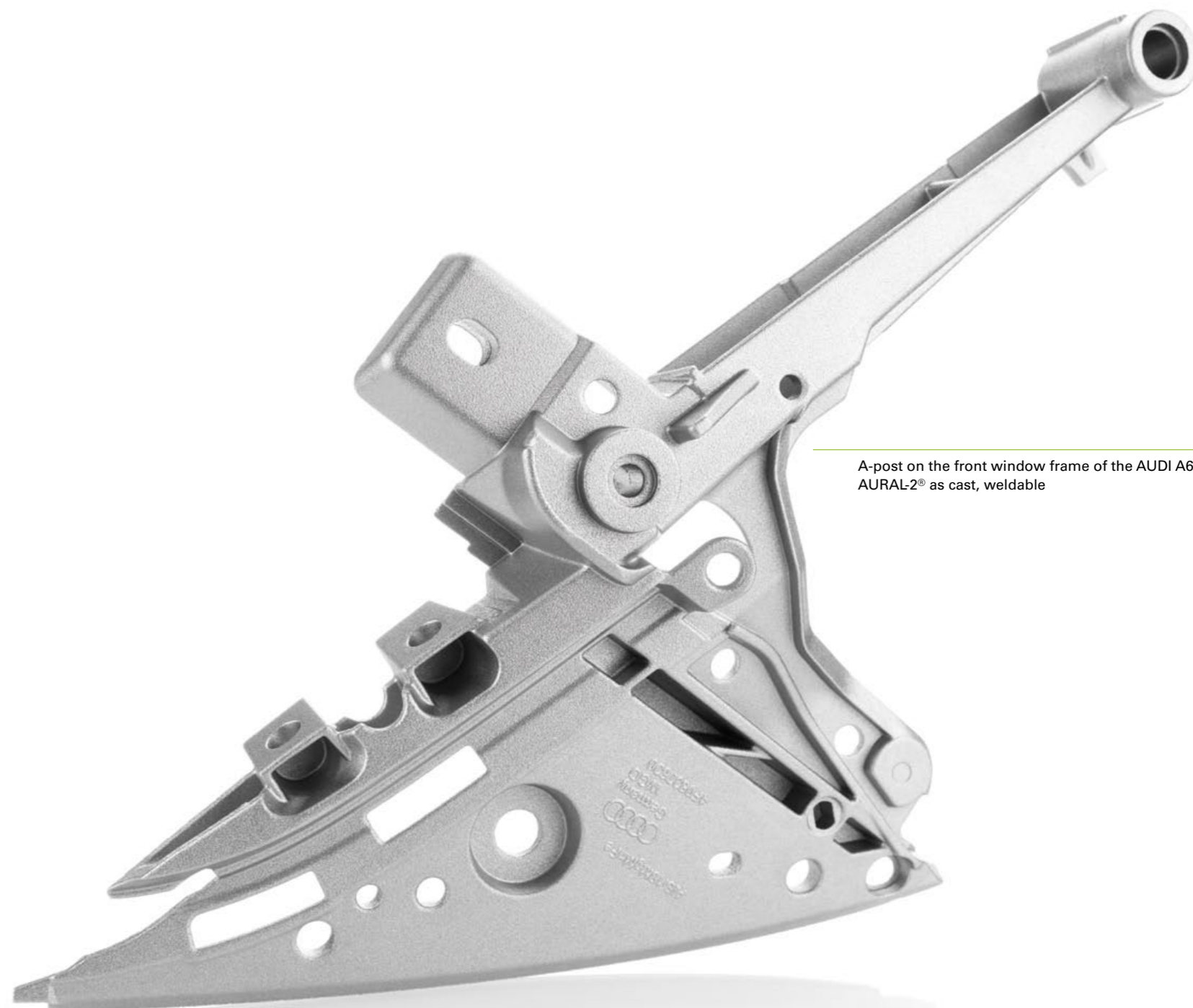


### All in one package

- **MFT technology**  
Maximum efficiency in powertrain parts production
- **HIGH-Q-CAST® process**  
Vacuum high pressure die casting for ultimate requirements
- **AURALTHERM®**  
Low-distortion heat treatment for components subject to impacts

We don't dream about the future, we shape it

Only those with a wealth of experience have the vision to shape the future.



A-post on the front window frame of the AUDI A6  
AURAL-2® as cast, weldable

Volkswagen cylinder head cover  
Alloy: GD-AISI9Cu3



## Quality product in 10 milliseconds

MFT technology allows us to make cast parts to a previously unparalleled standard of quality.

The unique MFT technology (Minimum Fill Time high pressure die casting) combines efficiency with pinpoint component precision. MFT enables high quality cast products to be produced within 10 - 50 milliseconds. Computer-based control of the shot profile allows us to achieve component features that open up completely new design horizons. For example, MFT technology played a large part in the development of the AUDI space frame.

Currently BDW technologies uses the MFT process mainly for powertrain parts in conjunction with secondary alloys. Optimum exploitation of the material/performance ratio allows for an extremely efficient and ecological casting process.

The high levels of quality placed by the automotive industry on mechanical properties, pore classification and joining features are met by a steady process control system. Thanks to a precise ingate calculation and optimum advance casting simulation, together with a fully monitored vacuum in series production, less casting pressure is required than with traditional processes. This has a positive effect both on the die life and the die casting machines.

The reliable MFT procedure has been successfully implemented at over 60 licensees throughout the world.

### Advantages at a glance:

- **Low gas content**  
Less porosity, good welding features, less scrap
- **Excellent mould filling**  
Reduced wall thickness, low component weight, reduced component costs
- **Less casting pressure**  
Higher die life, less impact on die casting machines



Typical industry efforts to improve the cast quality focus solely on the die cast machine process technology. However, a more advanced, reliable die cast machine is still no guarantee of efficiency and quality.

That's why BDW technologies takes an all-round approach to the process. Our development team considers every aspect of cast quality. From part development and die cast cavity design, to melting treatment and casting through to heat treatment. The results speak for themselves: our innovative High-Q-Cast® process has also been patented.

This vacuum high pressure die casting process produces high grade cast parts with high levels of weldability, dimensional accuracy and mechanical properties. The thin-walled, large-surface area and multifunctional components can be used in both the structure and chassis of the vehicle as well as the engine section. This economic process continues to find new fields of application in aluminium high pressure die casting, in particular in conjunction with AURAL® alloys and AURALTHERM® heat treatment.

## New opportunities with High-Q-Cast® technology

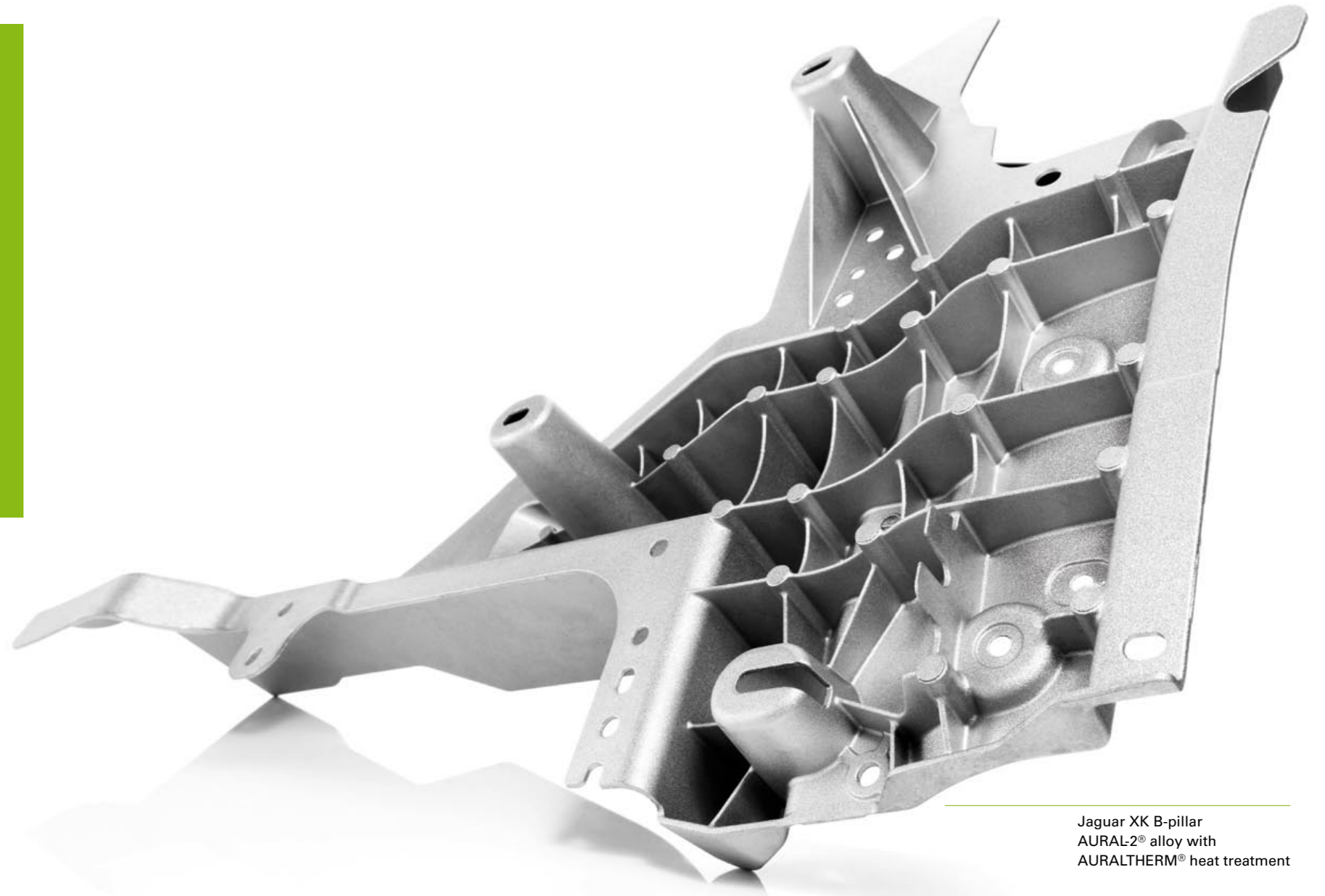
An economic and reliable vacuum high pressure die casting process to meet the most stringent quality requirements.



### Special features of High-Q-Cast® technology

- **Extremely low gas content levels**  
Porosity kept to a minimum, excellent welding features for all processes, ideal for mechanical joining processes
- **Excellent mould filling**  
Extremely low wall thicknesses, low component weight, large surface area components, low component costs
- **Less casting pressure**  
Higher die life, less rework, less impact on die-casting machines

For more details visit: [www.bdw-technologies.com](http://www.bdw-technologies.com)



Jaguar XK B-pillar  
AURAL-2® alloy with  
AURALTHERM® heat treatment



Outer A-pillar on AUDI A8  
AURAL-2® alloy with  
AURALTHERM® heat treatment

## Gentle air cooling instead of water quenching

**AURALTHERM® heat treatment: minimum distortion and maximum safety matched by lower costs.**

As part of its process and alloy development for large surface, thin walled structural components in the Audi A2 project, BDW technologies created its AURALTHERM® heat treatment system. In contrast to traditional solution heat treatment temperatures of around 500°C combined with conventional water quenching, the AURALTHERM® process involved "partial solution heat treatment" followed by air cooling. In order to meet the highest ductility requirements, this allows the necessary eutectic silicon to be spread, thereby reliably achieving the high elongation levels required for components subject to impact. At the same time the distortion, which can only be a few tenths of a millimetre in automated series production, is considerably reduced. The mechanical strength properties of the components are attained in a reproducible manner during the subsequent ageing at ambient temperature. Placing the components in individual "mono racks" ensures a consistently high cooling-down ratio. Furthermore the improvement in positioning the cast part in its individual suspension reduces re-alignment work.

BDW technologies' technology advantage allows different programs, all operating on its in-house heat-treatment system, to be adapted reliably to the specific needs of the components. Through permanent control improvements, both structural components and suspension parts for large series can be heat-treated on the same system, despite having different requirements. As well as individually controlling all the furnace units in the system, each carriage is monitored in real time. BDW technologies can thereby ensure the required level of reliability and component traceability.



Morphology of eutectic silicon  
Fig. 1: as cast condition  
Fig. 2: after heat treatment with ideally spread eutectic silicon

B pillar example showing deformation after heat-treatment  
Fig. 3: maximum dimensional accuracy with AURALTHERM®  
Fig. 4: significant dimensional deviation with water quenching

### Special features of AURALTHERM® technology

- **Partial solution heat treatment and air cooling**  
Low distortion heat treatment, minimum re-alignment
- **Precise tuning to AURAL® alloys**  
Best possible mechanical properties for various applications
- **PLC controlled and monitored continuous heat treatment furnace**  
Large lot size, high level of process safety, exact traceability

Aluminium high pressure die cast components are commonly used in engines, transmissions, as structural components in car body design and in chassis. Individual components can be incorporated in lightweight designs through modern melting technology. Each component application requires customised features that can be ideally adjusted through alloying and, if necessary, heat treatment.

Alongside the typical standard die cast alloys (secondary alloys), the specially developed AURAL® alloys (primary alloys) are used in the High-Q-Cast® process.

Both the standard alloys used by BDW technologies and the in-house developed AURAL® family reliably meet the requirements of all the application areas of the automotive industry.



#### Features of BDW technologies alloys

- Ideal basis for subsequent heat treatment.
- Outstanding mechanical properties for all application areas.
- Low gas content through a sophisticated melting line.
- Used in components with very thin walls and low dimensional tolerances.
- Ideal joining characteristics for all applications.

## At home in most components

Customised component features with aluminium die cast alloys.



Outer A-pillar on AUDITT  
AURAL-2® alloy with  
AURALTHERM® heat treatment

# A milestone in alloy development

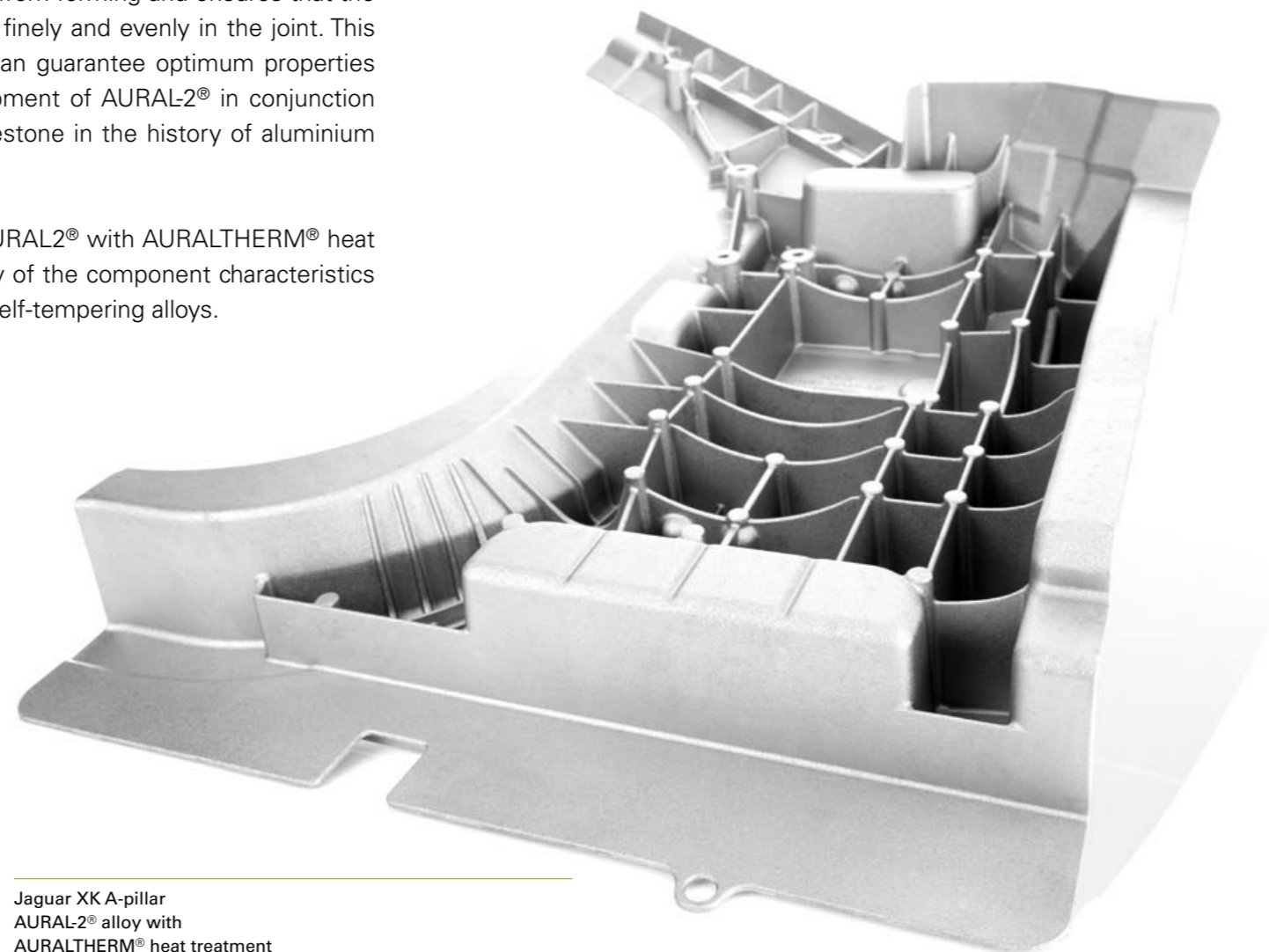
**AURAL-2<sup>®</sup>, the innovative die cast alloy for structural components subject to impact.**

The AURAL-2<sup>®</sup> die cast alloy has been specially developed to manufacture large-surface, thin-walled cast parts with complex geometries. It is used for example in structural components and the cast nodes of the Audi A2, Audi A8, Audi TT Jaguar XK, as well as in modern hybrid structures such as the BMW X5 or AUDI A6.

The AURAL-2<sup>®</sup> die cast alloy was designed on the basis of the aluminium silicon system. The Si content is kept close to the eutectic point. This ensures an optimal flow and mould filling capacity at a suitably low melting point. Our designers concentrated on achieving the best casting performance with the lowest thermal impact on the tools.

Compared with traditional die cast alloys, the iron content of AURAL-2<sup>®</sup> has largely been replaced by manganese to reduce the risk of partial alloying (sticking) to the die casting cavity. Choosing the right manganese/iron ratio prevents the needle shaped AlFeSi phase from forming and ensures that the quaternary AlFeMnSi phase is distributed finely and evenly in the joint. This is the only way that BDW technologies can guarantee optimum properties under all material conditions. The development of AURAL-2<sup>®</sup> in conjunction with AURALTHERM<sup>®</sup> is considered a milestone in the history of aluminium high pressure die casting.

Even today, current substitutions using AURAL2<sup>®</sup> with AURALTHERM<sup>®</sup> heat treatment are testament to the superiority of the component characteristics compared with cast parts produced with self-tempering alloys.



Jaguar XK A-pillar  
AURAL-2<sup>®</sup> alloy with  
AURALTHERM<sup>®</sup> heat treatment

## Data sheet: AURAL-2<sup>®</sup> alloy

(The listed data is subject to part-specific variations. Issue June 2007)

### Mechanical features as cast and after various heat treatments

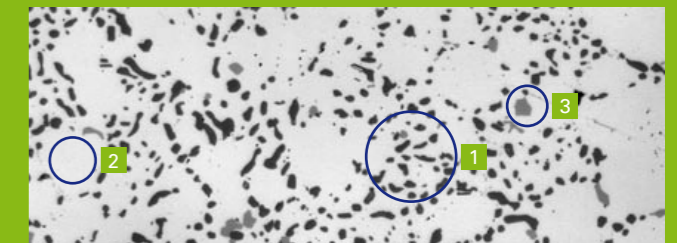
Status:	R <sub>p0,2</sub> (MPa)	R <sub>m</sub> (MPa)	A <sub>5</sub> (%)
F as cast	120-150	250-310	4-8
T5 status	150-240	270-330	3-7
T4 for maximum ductility	100-150	200-260	15-22
T6 for maximum strength	160-270	240-320	6-12
O soft annealing	90-110	180-210	10-18
AURALTHERM <sup>®</sup> partial solution heat treated with low distortion cooling	120-140	180-220	14-20
AURALTHERM <sup>®</sup> solution heat treated with low distortion cooling	140-160	210-240	6-14

### Chemical composition of AURAL-2<sup>®</sup> alloy by weight %:

	Si	Mn	Mg	Fe	Ti	Sr
min.	9,5	0,3	0,1	-	-	0,010
max.	11,5	0,6	0,4	0,25	0,1	0,018

### Micrograph

(After AURALTHERM<sup>®</sup> heat treatment)



- Strontium-refined AlSi eutecticum (1)
- Fine dendritic grain (2)
- Globulitic generated AlFeMnSi phase through optimum Mn/Fe ratio (3)

### Application areas:

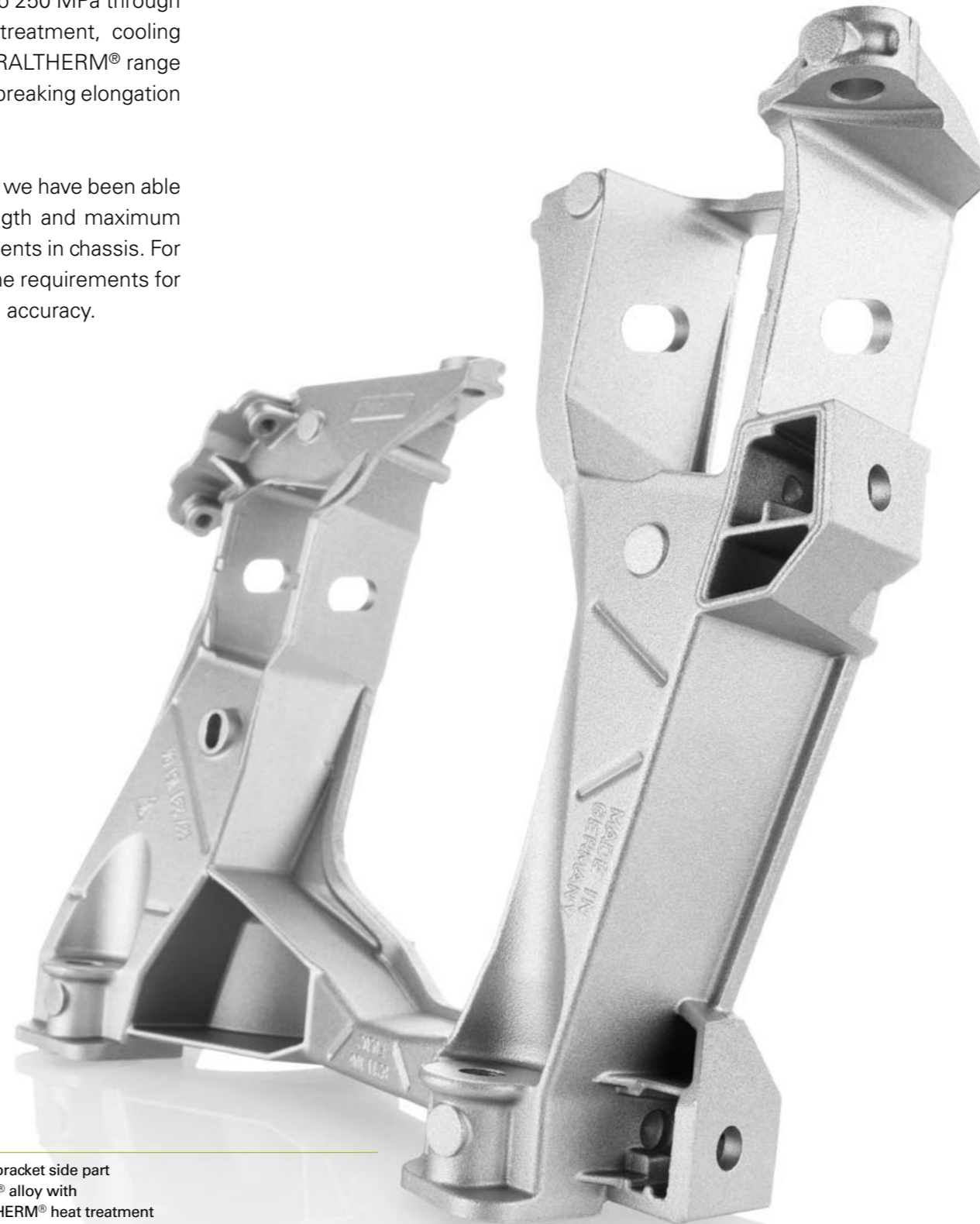
- Structural components subject to impacts

## Opposite features united

**AURAL-3<sup>®</sup>, high pressure die cast alloy for high strength and maximum ductility.**

AURAL-3<sup>®</sup> is an AISi cast alloy with a silicon content close to the eutectic point. Compared with the AURAL-2<sup>®</sup> alloy AURAL-3<sup>®</sup> contains considerably more magnesium. Combined with AURALTHERM<sup>®</sup> heat treatment modified for this alloy, the yield strength has been increased by up to 250 MPa through suitable temperature modification during solution heat treatment, cooling and ageing. Typical tensile strengths for this alloy with AURALTHERM<sup>®</sup> range between 210 and 300 MPa. Despite these extreme levels, breaking elongation levels of between 5 and 12% can be attained reliably.

With the revolutionary development of the AURAL-3<sup>®</sup> alloy, we have been able to combine opposite material properties – ultimate strength and maximum ductility! This demanding feature is ideal for safety components in chassis. For example, the rear axle bracket side part shown meets all the requirements for mechanical properties, pore classification and dimensional accuracy.



Porsche bracket side part  
AURAL-3<sup>®</sup> alloy with  
AURALTHERM<sup>®</sup> heat treatment

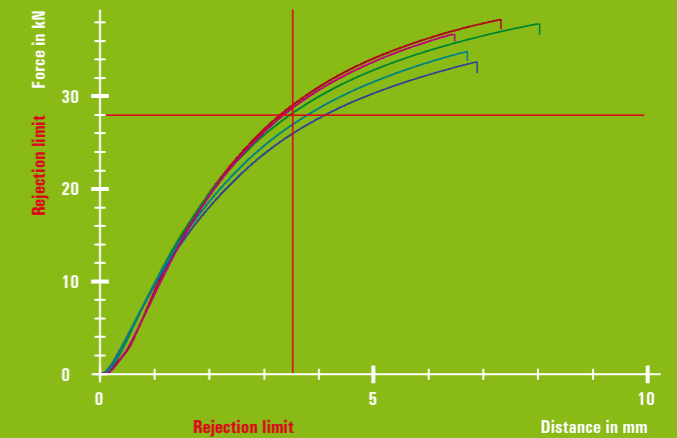
### Data sheet: AURAL-3<sup>®</sup> alloy

(The listed data is subject to part-specific variations. Issue June 2007)

**Mechanical features as cast and after  
AURALTHERM<sup>®</sup> heat treatment**

Status	R <sub>p0,2</sub> (MPa)	R <sub>m</sub> (MPa)	A <sub>5</sub> (%)
AURALTHERM <sup>®</sup>	180-250	210-300	5-12

**Proven suitability for serial production through  
component testing**



**Result:**

- Breaking force and deformation curve overlap repeatedly far beyond the rejection limits

**Chemical composition of AURAL-3<sup>®</sup>  
alloy by weight %:**

	Si	Mn	Mg	Fe	Ti	Sr
min.	9,5	0,3	0,4	–	–	0,010
max.	11,5	0,6	0,6	0,25	0,1	0,018

### Micrograph

(After AURALTHERM<sup>®</sup> heat treatment)



- Ultimate strength and maximum ductility due to optimum spread of eutectic silicon (black)

**Application areas:**

- Safety components in chassis

# A revolutionary invention

**AURAL-5<sup>®</sup>, maximum ductility – even as cast.**

The AURAL-5<sup>®</sup> alloy has been specially developed for “ductile oil pans” that comply with the minimum chip resistance requirement of 88 Joules. No cracking must occur on the cast part surface if an 8 cm diameter steel ball drops from a height of 4 metres. With traditional alloys, cracks occur on impact of the steel ball. This brittle effect can normally be avoided only by complicated, costly heat treatment.

This is not the case with the new AURAL-5<sup>®</sup> alloy: Here, the necessary ductile effect is already provided with the cast product. As well as elongation levels of between 5 and 12 %, the required hardness for a safe connection, in excess of 70 HB, is also maintained. Compared with the AURAL-2<sup>®</sup>/AURAL-3<sup>®</sup> alloys, the AURAL-5<sup>®</sup> alloy, while maintaining excellent cast features, also offers an optimum eutectic proportion by reducing the Si content. This makes the AURAL-5<sup>®</sup> alloy universally applicable to all high grade cast components.

Traditionally produced oil pan (GD-AISI9Cu3) with brittle characteristics and evident crack formation for an 88 Joule drop force.



Oil pan as cast AURAL 5<sup>®</sup> with ductile material characteristics and no crack formation for a drop force in excess of 120 Joules.



## Data sheet: AURAL-5<sup>®</sup> alloy

(The listed data is subject to part-specific variations. Issue June 2007)

### Mechanical features as cast

Status	Rp0,2 (MPa)	Rm (MPa)	A5 (%)	Hardness (HB)
F as cast	120-150	250-310	5-12	70-90

### Results from a ball dropping test series with a sump from a rising drop height

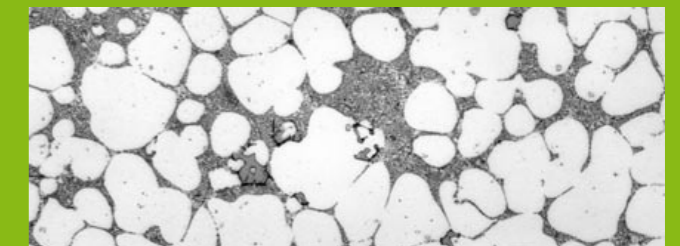
h (m)	M (kg)	E (J)	Crack formation	Leak test
4,60	2,13	96,12	none	passed
5,00	2,13	104,48	none	passed
5,40	2,13	112,83	none	passed
5,80	2,13	121,19	none	passed
6,20	2,13	129,55	none	passed

### Chemical composition of AURAL-5<sup>®</sup> alloy by weight %:

	Si	Mn	Mg	Fe	Ti	Sr
min.	6,5	0,3	0,1	–	–	0,010
max.	9,5	0,6	0,6	0,25	0,1	0,018

### Micrograph

(As cast)



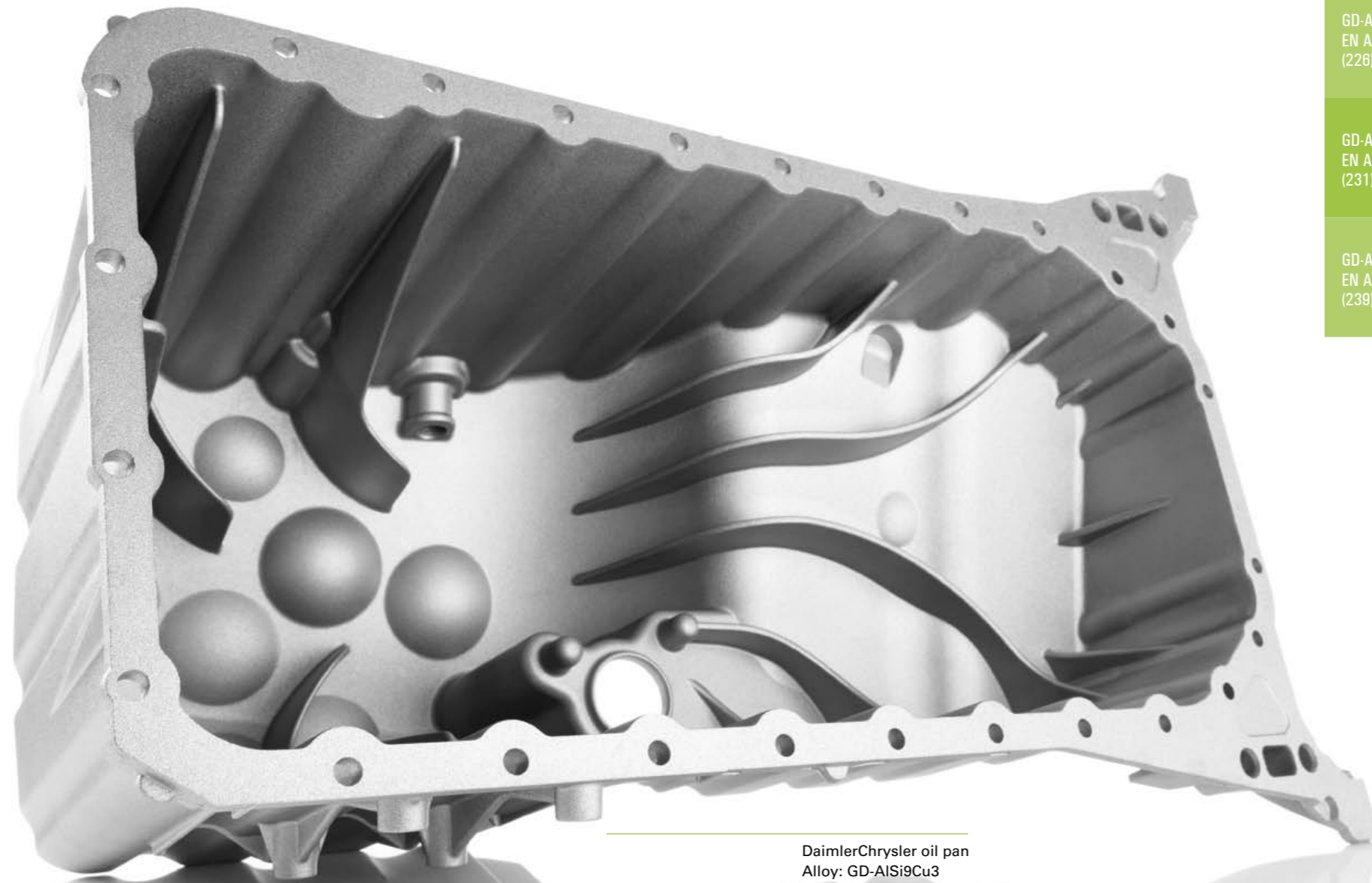
- Very fine eutecticum (dark areas) due to refinement
- Fine dendritic grain (light areas) due to core refinement
- Globulitic generated AlFeMnSi phase through optimum Mn/Fe ratio

### Application areas:

- Ductile oil pans

## The ultimate alloys

Standard and secondary alloys for outstanding flow and mould filling properties.



DaimlerChrysler oil pan  
Alloy: GD-AISI9Cu3

The AURAL® family of alloys are primarily molten cast alloys with the highest purity levels. Standard die cast alloys receive secondary melting, i.e. are produced by melting recycling materials. With their excellent flow and mould filling properties these standard die-cast alloys are extremely versatile. Casting these tempering alloys with the MFT casting process produces a quality to meet all the main mechanical and leak-proof requirements.

With our alloying and heat treatment expertise, the composition of these standard alloys can also be specified or modified beyond the norm. This can result in new properties for particular applications. When cast with the MFT process these components are easy to warm-treat and weld, thanks to the low gas content.

Alloy description	Mechanical properties for separately cast specimens			Application instructions
	Rm (MPa)	Rp0,2 (MPa)	A5 (%)	
GD-AISI9Cu3 EN AC-46000 (226)	240	140	< 1	Versatile alloy, can also be used for complex cast parts
GD-AISI12Cu1 EN AC-47100 (231)	240	140	1	For complex thin-walled cast parts
GD-AISI10Mg EN AC-43400 (239)	240	140	1	For complex, thin-walled, pressure and vibration resistant cast parts with maximum strength after tempering and excellent corrosion resistance.



BDW technologies is the preferred development partner for a large number of prestigious and premium projects in the automotive industry. Our engineers collaborate with customers from the very beginning of the project to bring BDW technologies' extensive development expertise to bear.

However in order to remain ahead of the market, BDW technologies conducts its own research and development projects. As well as the established processes and alloys described above, we offer our clients customised solutions.

This brochure can only offer a general overview of BDW technologies' range of services. Please contact us if you require more detailed information. We would be delighted to advise. Alternatively, please visit us in Markt Schwaben.



### Why choose BDW technologies as your project development partner?

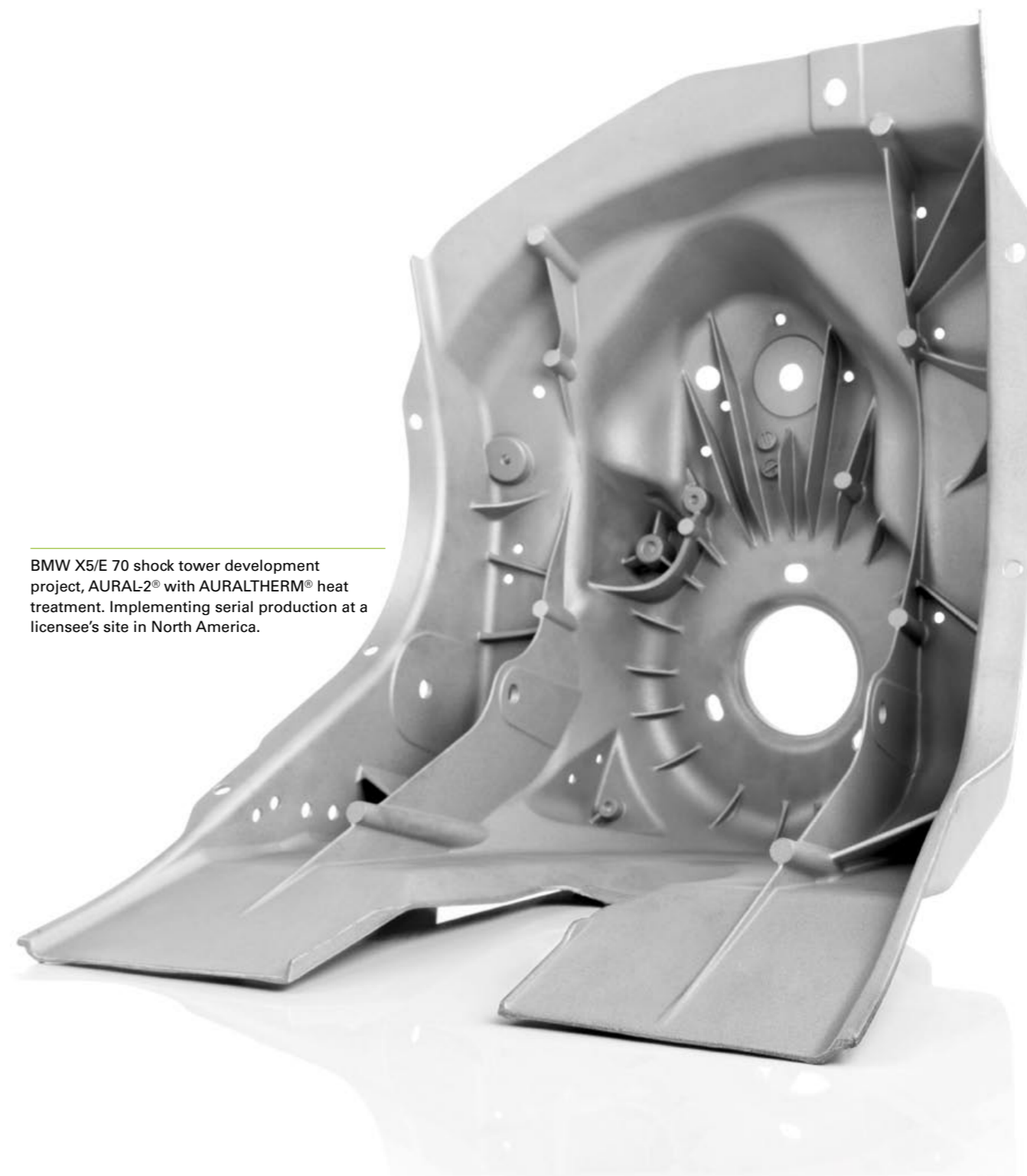
#### BDW technologies

- is the preferred development partner to the automotive industry.
- operates from the start of the project with the customer's development team, offering professional advice.
- offers customised solutions, tailored to our customers' needs.

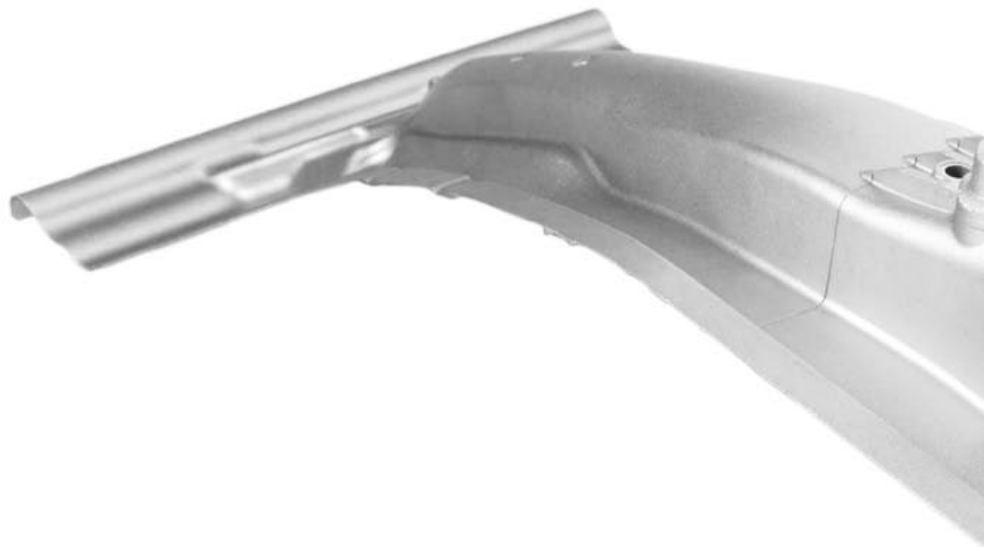
Contact us for further information.

## Your premium project development partner

Expert advising of our customers' research and development departments – meeting your specific requirements.



BMW X5/E 70 shock tower development project, AURAL-2® with AURALTHERM® heat treatment. Implementing serial production at a licensee's site in North America.



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