

Setting new global standards

Dievar & AM Dievar

**PUSHING PERFORMANCE
TO NEW LIMITS**



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THE BEST JUST GOT BETTER

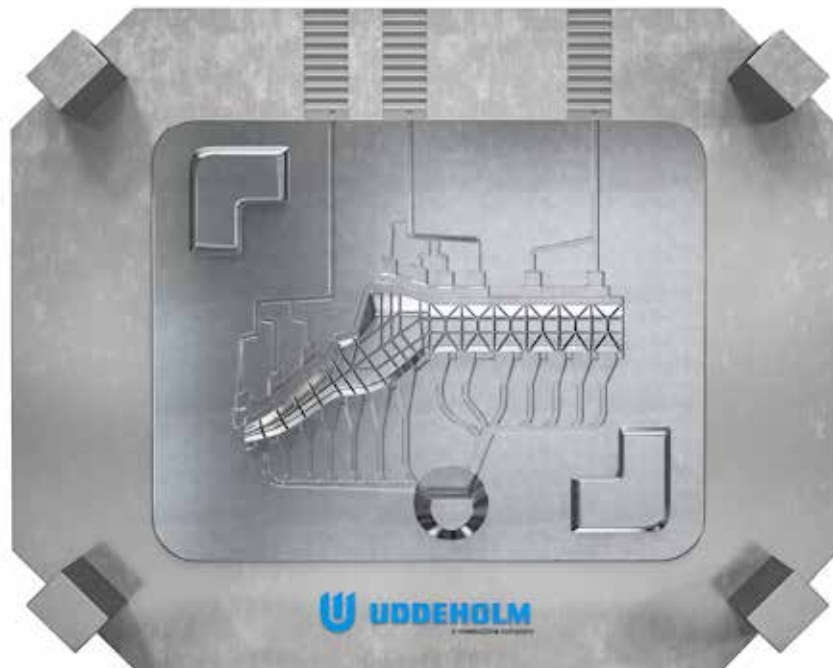
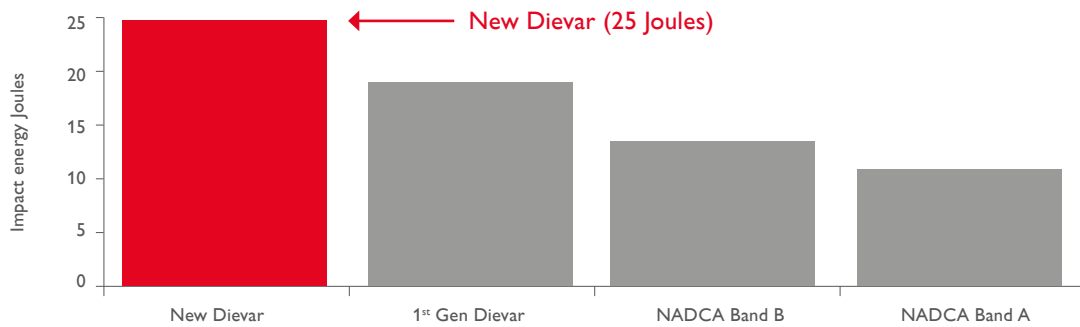
SETTING NEW GLOBAL STANDARDS

The most demanding production projects will get access to a new level of performance against heat checking and cracking.

A NEW LEVEL OF PERFORMANCE

ASSAB presents a new solution for common problems and future challenges, with a new level of toughness. The previous premium level of delivered toughness was a minimum average of 19 Joules.

Today Dievar sets a new global standard of 25 Joules. Market leading metallurgy and production techniques has enabled an outstanding upgrade in performance.

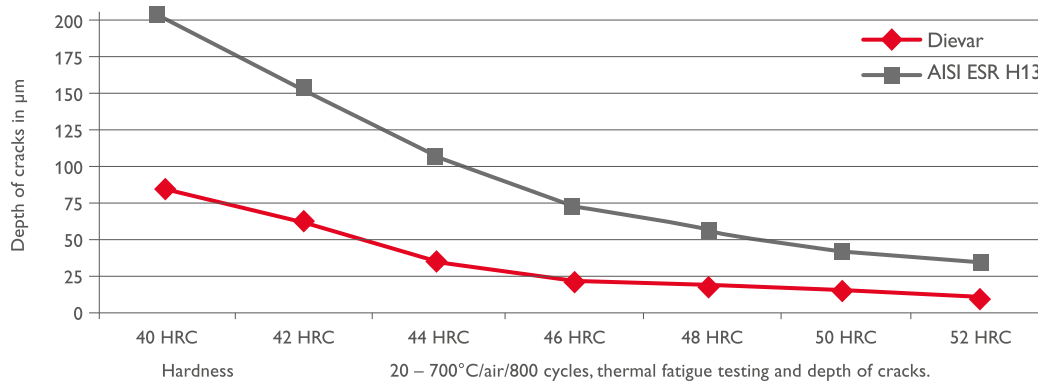


A UNIQUE GRADE WITH VALUABLE PROPERTIES

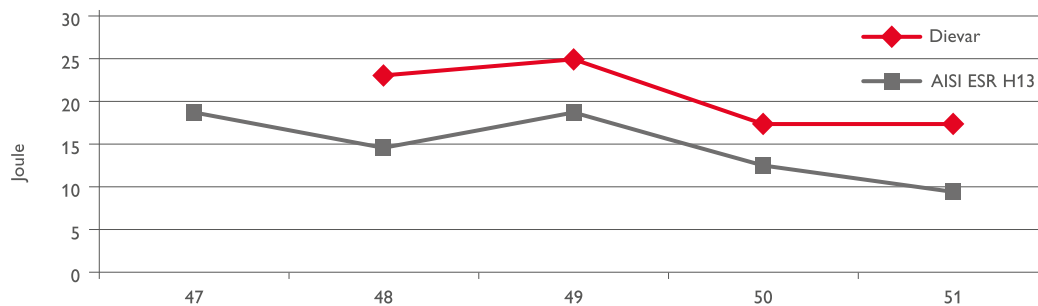
RELIABLE AND CONSISTENT PRODUCTION

Dievar can help make your tools more reliable and consistent in production. The most common repair of HPDC tooling is heat checking damage.

What happens with higher HRC?



Toughness at different hardness levels



DESIGNED TO DELAY HEAT CHECKING

To prevent the initiation and propagation of heat check cracks you need high ductility and high toughness. These properties are a direct effect of the chemistry and the development process of Dievar over recent years.

Dievar's outstanding heat checking resistance over AISI ESR H13 can be seen in the chart from 40HRC up to 52HRC. Dievar's properties yield the highest possible level of heat checking resistance in order to reduce the life time costs of the die. It is a known fact that higher hardness delays

heat checking, but the risk of cracking in the tool increases. Dievar has been internally tested at higher hardness ranges to show how it performs. As tested, Dievar was excellent in every hardness range to AISI ESR H13. Now you can have the best of both worlds, high heat checking resistance combined with new levels of toughness to help you get the best performance from your dies.

IMPROVED DIE ECONOMY

STRENGTH AND SUPPORT FOR ALL SIZES

Longer die life and reliable production are possible when using Dievar.

ANSWERS TO TODAY'S CHALLENGES

Due to the growth in large structural automotive parts and other e-mobility parts, we see dies expanding in size and tooling becoming more complex. New aluminium types, higher melting temperatures and dies with more gates than a

traditional part are all pointing to lower die life with heat checking as the major cause when compared to traditional cast parts. This battery box example shows where die life can be very low.

Typical battery box min and max production values from customer feedback. These customers are now so confident using Dievar they guarantee the die life to their end user.

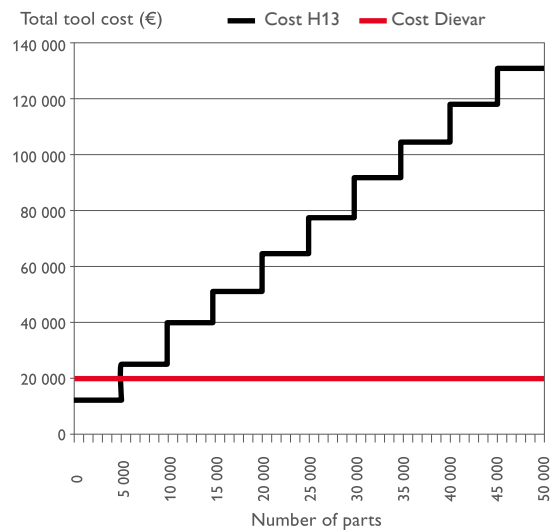
Die Type	Die Steel	*Min/Max shots
Large Battery box	AISI ESR H13	<40K - 60K
Large Battery box	Dievar	80 - 100K

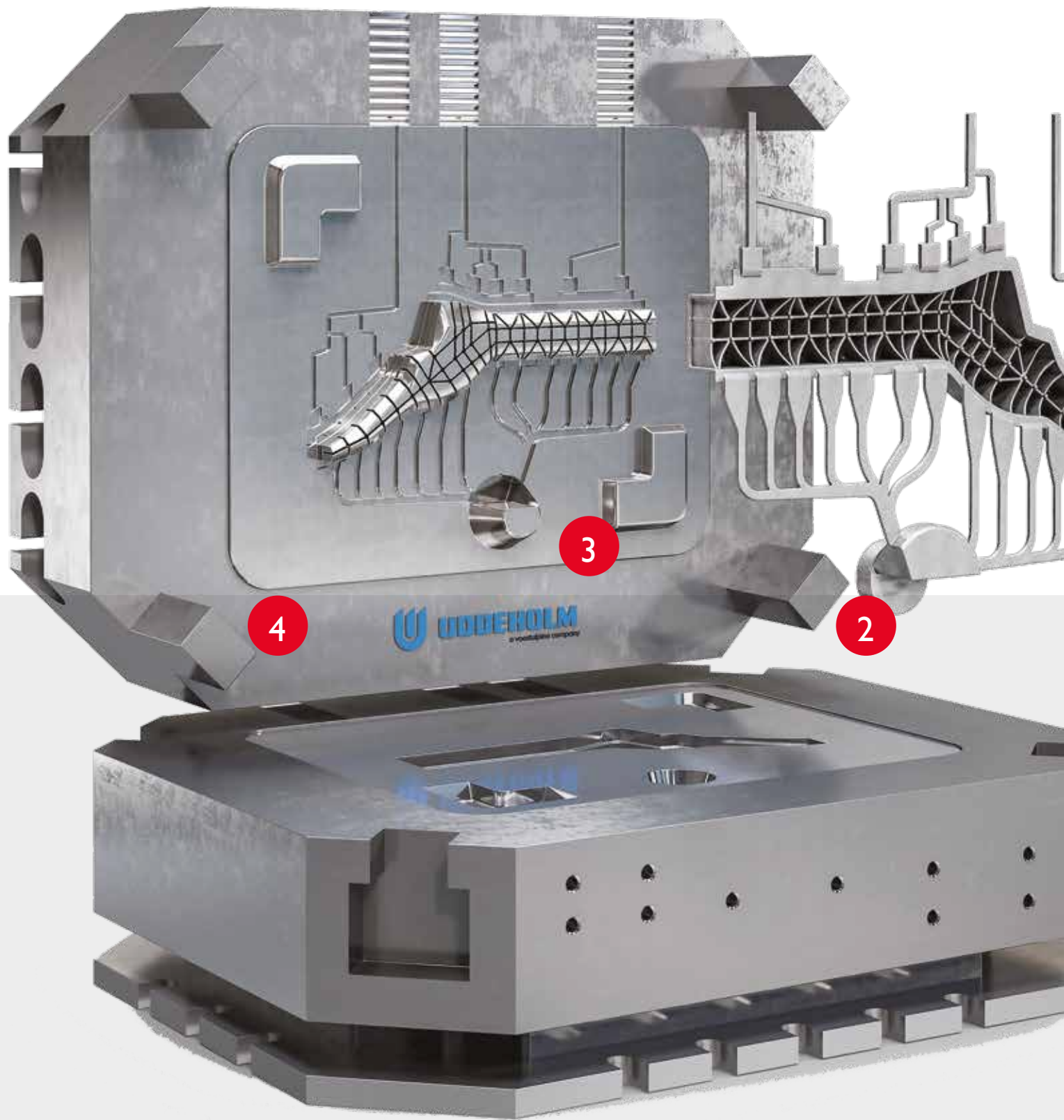


Using Dievar over AISI ESR H13/H11 can have serious financial benefits. It has proven itself superior to AISI ESR H13/H11 for heat checking damage, which can potentially save lots of lost

value in production volumes. The cost per part, press productivity and a reduction in the overall tooling cost can be achieved as the following customer case shows.

Steel grade:	H13	Dievar
A. Tool steel cost (€)	7 000	14000
B. Tool making cost (€) (soft machining, HT, hard machining, polishing, adjusting etc)	6 100	6 300
C. Total tool cost (€), (A+B)	13 100	20 300
D. No. of parts/tool (tool life)	5 000	50 000
E. Total tool cost/part during tool life (€)	2.62	0.41
F. Production (Number of parts)	50 000	
G. Total tool cost/part during F (€)	2.62	0.41





DIEVAR – FOR THE MOST DEMANDING OF APPLICATIONS

ADVANCED TECHNOLOGY NEEDS NEW SOLUTIONS

Dievar will push you a step further in preparation for coming trends. Due to the growth in large structural automotive parts, the risk of cracking, heat checking and unexpected expensive maintenance stops are common problems today. Dievar is the steel you need to remain profitable in an innovative automotive industry.



KEEP PRODUCTION RUNNING

To keep costs down in the long run, you need a tool steel solution that not only can handle the most demanding designs and cooling cycles, but

also can push you a step further in preparation for coming trends.

1

1 RUNNERS
Dies which run on higher injection speeds demand a tool steel with excellent erosion resistance, temper-back resistance, hot strength, creep strength and weldability for ease of repair.

2 MULTIPLE GATES
Larger dies with multiple gates need excellent erosion resistance, temper-back resistance, thermal fatigue resistance and weldability.

3 COMPLEX DESIGN
Demanding modern designs push inserts and die blocks too the limits. Excellent toughness and ductility are critically important to get maximum die life.

4 LARGE INSERTS AND DIES
Large parts need large inserts and dies, which require the best toughness possible in combination with excellent heat checking resistance, hardenability and weldability.

BE PREPARED FOR THE NEW TRENDS

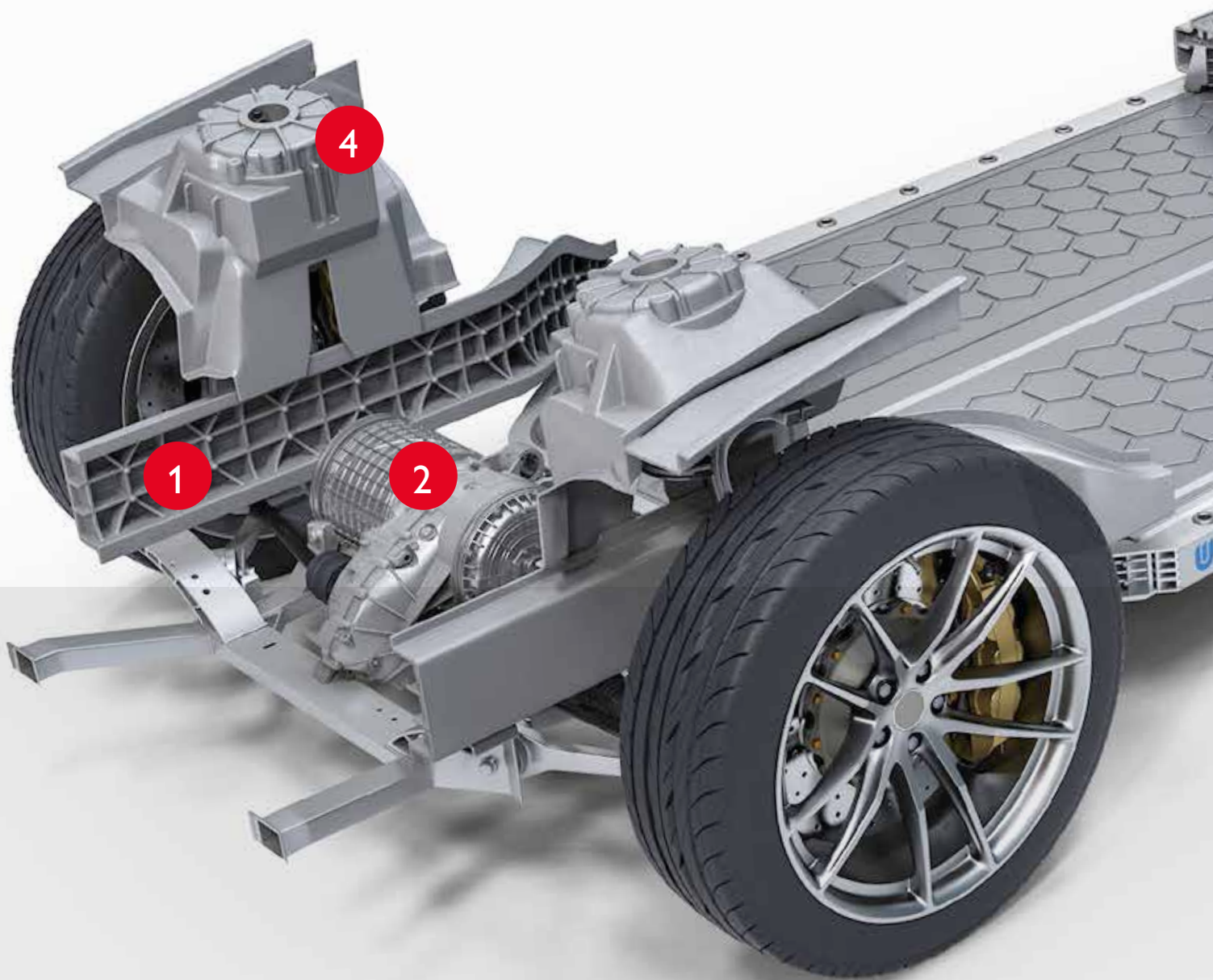
DEVELOPED FOR E-MOBILITY

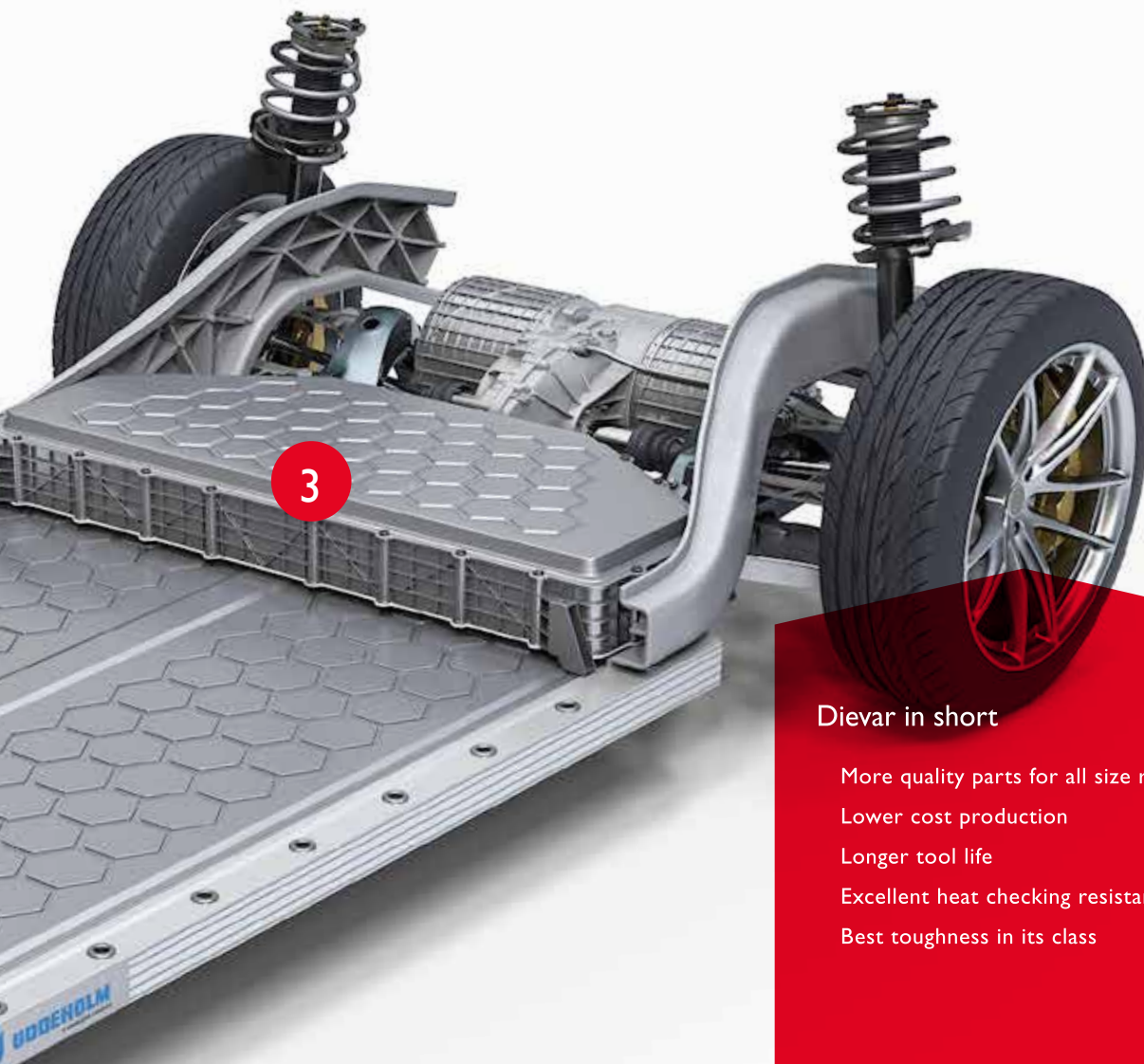
Keep your productivity rates up by using Dievar.

READY FOR THE FUTURE

The complex geometries and quality requirements of new e-mobility parts are pushing die life demands to new levels.

Covering the whole HPDC package, Dievar has the answer to long production volumes in these challenging new parts.





Dievar in short

- More quality parts for all size ranges
- Lower cost production
- Longer tool life
- Excellent heat checking resistance
- Best toughness in its class

1

STRUCTURAL PARTS

These parts have large surface areas with thin and thick sections and demand a high quality surface finish. Parts cannot have heat checking damage on them but this is a challenge due to the multiple gate designs.

2

ELECTRIC MOTOR HOUSINGS

Large cast parts with high demands on quality can suffer from heat check damage, erosion and soldering in complex section areas.

3

BATTERY PACKS AND BOXES

Battery packs can be very large and the weight means lots of heat into the tool. Heat checking damage is often not allowed on the outside faces and die life can be low compared to a traditional cast part.

4

REDUCED PRODUCTION

Feedback from customers shows that these new part types are running much lower volumes than expected because of high heat checking damage levels. Typical examples are shock tower dies where the goal would be +60K. However, some report under 30K in AISI ESR H13/H11 dies.



TOUGHNESS, TOUGHNESS, TOUGHNESS!

AM DIEVAR FOR ADDITIVE MANUFACTURING

The AM solution to applications that require high toughness

THE PROMISE OF AM IN HPDC

Over many years, customers in a variety of industries have been experimenting with various forms of Additive Manufacturing (AM) in tooling applications. The various AM processes promise to open up production to increase efficiency from existing tooling and in particular the segment of High Pressure Die Casting (HPDC). HPDC is an area which suffers more than most with problems associated with extreme heat exposure and heat dissipation. For example, a typical core pin in an HPDC die is subjected to temperatures $>600\text{ }^{\circ}\text{C}$ depending on the alloy used.

As the process is cyclical, over long production time this can degrade the tool steels ability to hold its shape and maintain integrity. The tool steel often used in this application is Dievar as it has the properties to delay this degradation. But even Dievar can be limited by conventional toolmaking, which can only place cooling channels where drills can reach with conventional milling and drilling machines. Covering the whole HPDC package, AM Dievar has the answer to long production volumes in these challenging new parts.

AM Dievar in short

- High toughness
- High ductility
- Good characteristics for printing



THE DRAWBACK OF CURRENT MATERIALS

AM and in particular via the Laser Powder Bed Fusion (L-PBF) process can change this with the introduction of conformal cooling, which is the ability to place cooling channels where they are needed in the insert, or core, to maximise thermal regulation. However, current popular powders used in this area often do not have the chemical or mechanical properties desired to optimise the most effective conformal cooling designs.

If we take the most widely used material in the L-PBF segment, 1.2709, this is a maraging steel and while it has good properties for printing, it does not necessarily have the best properties for the application. For example, if you take common failures in HPDC, Soldering and Erosion, then 1.2709 is more prone to both because of its chemistry limitations when compared to a material like AM Dievar. Another more common failure in HPDC is thermal fatigue/heat checking, which is often the main reason a die or tool finally stops the production. On occasion gross cracking can happen, but both thermal fatigue and gross cracking are more common if materials with insufficient ductility and toughness are used.

When testing AM manufactured samples of 1.2709 material in the horizontal build we found just $\approx 160\text{J}$ at 46/48HRC. This low level of ductility in production can lead to early heat checking or even gross cracking of the parts. Covering the whole HPDC package, AM Dievar has the answer to long production volumes in these challenging new parts.

AM DIEVAR – THE HPDC SOLUTION

If we compare Dievar when produced using the P-ESR route (Pressurised Electric Slag Remelting) to the AM manufactured 1.2709, with a ductility level reported of about 160J, the difference is clear. You would expect to see the Dievar (P-ESR) test $>350\text{J}$ at 46/48HRC. This high level of ductility is the basic property most tool users are asking for when making complex inserts in AM manufacture. When testing impact toughness in Dievar (P-ESR) at 46/48HRC you would expect a figure $>20\text{J}$ depending on the size of the block tested.

With AM Dievar, you have a material that shows all of the properties of the P-ESR material but now with the benefit of using the AM process. This powder also has the hot properties customers are looking for in AM but is lacking in grades such as 1.2709, i.e. better soldering and heat checking resistance.

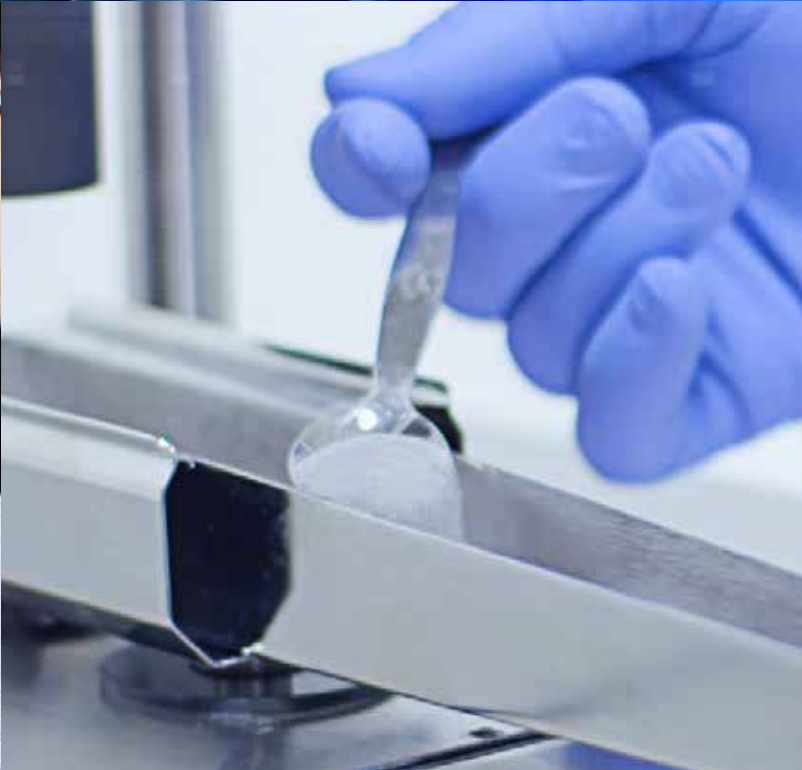
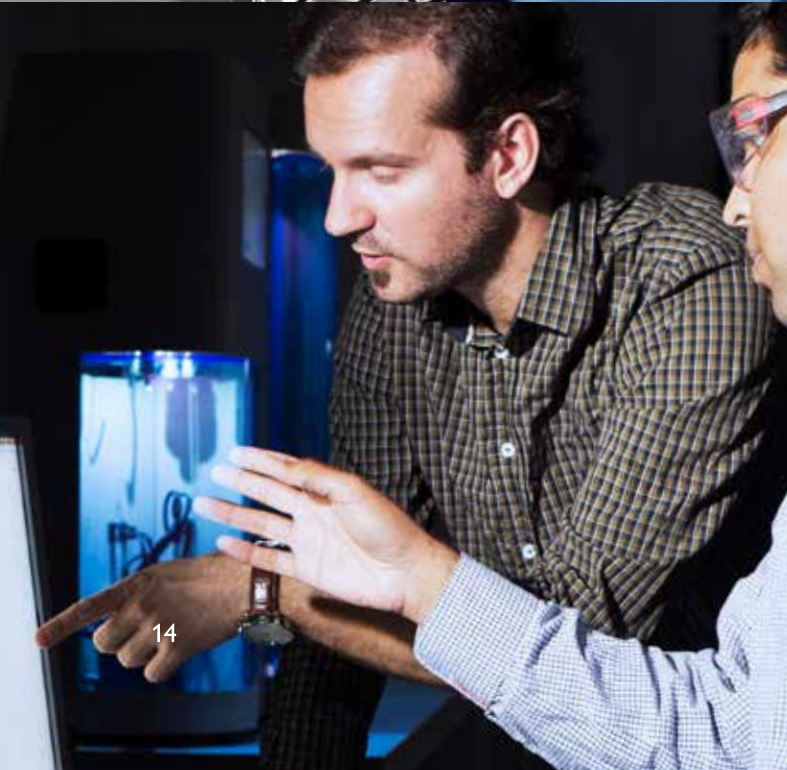
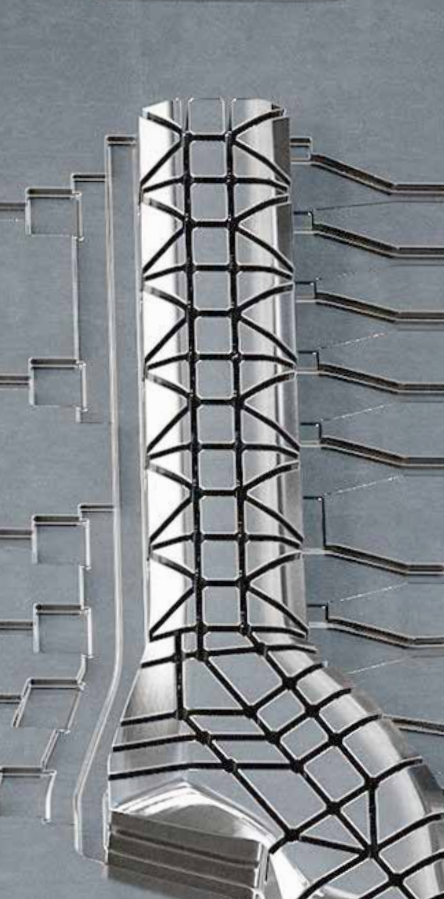
The material is very versatile and can be printed in low heat chambers ($160\text{ }^{\circ}\text{C}$) printers such as in the EOS M290 machine. AM Dievar can be used to make designs of complex geometry with good properties when following our parameters as a guide.

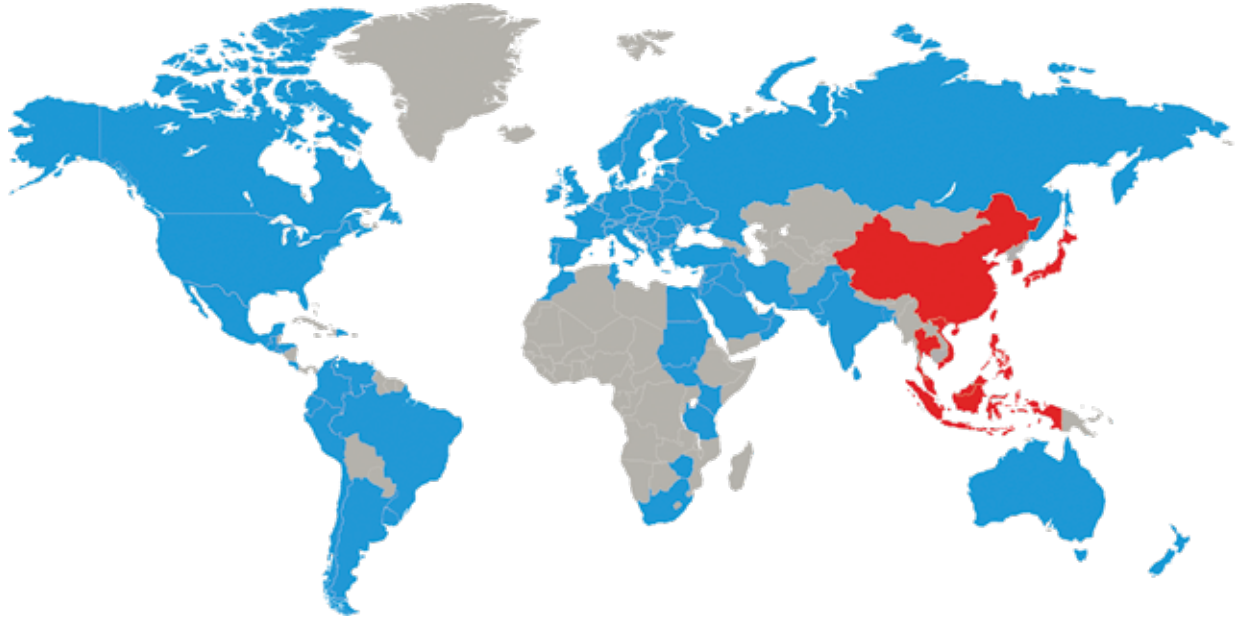


AM DIEVAR WITH LASER METAL DEPOSITION

Utilising AM Dievar with the LMD (Laser Metal Deposition) process, one can repair worn die surfaces in application areas such as Hot Stamping, Forging and Extrusion. The benefit with such approach is to avoid excessive material removal from traditional welding methods by instead implementing precise cladded layers on the worn surfaces.







Choosing the right steel is of vital importance. ASSAB engineers and metallurgists are always ready to assist you in your choice of the optimum steel grade and the most suitable treatment for each application. ASSAB not only supplies steel products with superior quality, but we also offer state-of-the-art machining, heat treatment, surface treatment services and additive manufacturing (3D printing) to enhance your tooling performance while meeting your requirements in the shortest lead time. Using a holistic approach as a one-stop solution provider, we are more than just another tool steel supplier.

In Asia Pacific, ASSAB anchors the distribution network for Uddeholm, a Swedish tool steel manufacturer with more than 350 years of experience in the tool steel industry. The two companies together service leading multinational companies (MNCs) in more than 90 countries.

For more information, please visit
www.assab.com

