Stuttgart / Aalen, 07 October 2021

PRESS RELEASE – ThinKing October 2021

A bumper for die casting makes components lighter

In cold chamber die casting, a lightweight casting plunger made of an aluminium alloy has multiple benefits. It is more flexible than its former steel counterpart, and much better able to absorb high forces at the end of the filling process. This results in a range of positive consequences for the process and for the environment, which is why this idea from Aage Aalener Gesellschaft für Leichtbauteile mbH – which can be retrofitted to almost any die casting machine – is receiving the ThinKing for the month of October.

The Baden-Württemberg State Agency for Lightweight Technology will be presenting this innovation with their ThinKing in October 2021. With this label, Leichtbau BW GmbH provides a monthly platform for innovative lightweight construction products or services from Baden-Württemberg.

At a glance:

- **Lighter components:** Blank cast components are up to four percent lighter, without any design modifications.
- **Improved precision:** The dimensional tolerances of the components can be significantly lower. Tolerances of just a few millimetres are possible.
- **Optimised material usage:** On the one hand, the service life of the moulds is extended, while on the other, the components contain less (excess) material.
- **Lower costs:** Reworking the components in the plane and removing burrs are obsolete.
- **Higher quality:** The porosity of the cast part is lower, due to improved feeding.

In cold chamber die casting, a liquid metal melt is pressed into a mould by a casting plunger, and hardens there to form the component. A speed of 20 to 50 m/s is required to fill the mould, since the metal melt would otherwise harden too quickly, and would not correctly fill the mould.

“To picture this speed, imagine filling your bathtub at home in just one second” says Dr. Friedrich Klein, founder and Managing Director of Aage Aalener Gesellschaft für Leichtbauteile mbH, providing a vivid comparison.

Since the metal melt is incompressible, the kinetic energy of the casting plunger has to be dissipated extremely quickly. “In the instant the mould is filled, the casting plunger moves at high speed, like it was hitting a steel wall. It goes from 5 meters per second to zero in a fraction of a millisecond”, Prof. Friedrich says, describing the raw forces that make the machine audibly shake each time during cold chamber die casting. Previous solutions used the machine hydraulics to dissipate the energy and tolerate the elastic deformation that occurs in the steel casting mould.

Aluminium bumpers

Developers at Aage Aalener Gesellschaft für Leichtbauteile mbH devised a new approach, which was successfully funded in a ZIM[1] project from 2009 to 2011. “Our casting piston - piston rod system for horizontal cold chamber die casting machines has a casting piston rod made of an aluminium alloy that absorbs the pressure shock at the end of mould filling” explains Dr. Norbert Südland, Head of Quality Management and Research, describing the system produced by the project. The casting piston rod is designed so that the sleeve never gets hotter than 30 °C. Only the casting piston comes into contact with the melt, which is around 600 °C.

With a Young’s Modulus of 75,000 N/mm^2, the aluminium alloy used in the new casting piston rod is much more elastic than steel, with a Young’s modulus of 220,000 N/mm^2. Because of this, the pressure peak at the end of the casting process compresses the casting piston rod, which acts as a bumper or crumple zone to absorb the kinetic energy. The pressure pulse this creates causes elastic deformation of the casting piston rod, instead of cracking or deforming the die casting mould. Aage GmbH’s development is patent-protected.

Lighter blank cast parts save resources

Since the casting mould experiences no deformation, it does not become “overfilled”. The cast component is lighter. 150 g of aluminium can be saved per mould filling for a pressure plate, for example, with the lightweight aluminium casting piston rod – at a component weight of 4,000 g. The same component would weigh 4,150 g with a steel casting piston rod.

Although this does not seem like much for an individual component, it adds up over larger quantities. The cold chamber die casting process is a highly efficient manufacturing method, and is used in large-scale series production because of this. Quantities of 100,000 parts per year are common.

Calculated based on the example above, using an aluminium casting piston rod would save 15 tons of aluminium per year.

Less material is good for the climate, and for your pocketbook

Less material is particularly good for the climate, because around 16 kWh/kg must be added for aluminium, as the energy required to produce the metal from bauxite. That not only represents an added expense, but also impacts the climate due to the CO_2 emissions resulting from energy production.

Since the casting piston absorbs the pressure peak, the casting mould experiences no deformation. This greatly improves the dimensional tolerance of the parts. In the past, dimensional tolerances for die cast parts have been around 0.4 to 0.5 mm at a component size of 400 mm. The dimensions of the blank cast parts cast from aluminium using a casting piston

[1] Zentrales Innovationsprogramm Mittelstand (Central Mid-Sized Businesses Innovation Program) (https://www.zim.de/ZIM/Navigation/DE/Home/home.html)

rod are precise down to just a few micrometres – meaning they experience much less burr formation.

Less or no flash, and better dimensional tolerance – in particular on the mould partition – also means less reworking. The estimated energy required for reworking is 8 kWh/kg, which is particularly high. In addition, less waste means added cash for the foundry.

Additional effects to make die casting more attractive

Moulds have a longer service life, which significantly impacts resources and costs, with multiple positive effects. Using less piston lubricant and mould release agent also improves environmental and financial calculations.

In addition to good dimensional tolerance, reducing the auxiliary materials, improved feeding, resulting in less porosity, and lower ejection forces all improve quality.

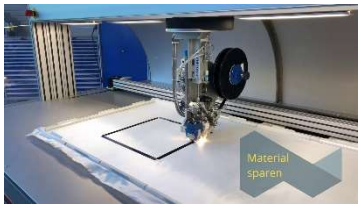
Not for off-the-shelf components

Development work was supported by Oskar Frech GmbH + Co. KG from Schorndorf, which provided the die casting machine for testing. Over the last few years, the system – consisting of a casting piston and piston rod – and its seals and process capabilities have been refined, so that foundries today can utilise all of the advantages of the lighter casting piston rod.

The casting piston and piston rod system can be easily retrofitted onto almost any die casting machine. It can be used in any industry; many cast parts are used in the automotive industry and in mechanical engineering. Components are designed, adapted, and manufactured for the specific application, following competent advising by Aage GmbH.

About Aage Aalener Gesellschaft für Leichtbauteile mbH

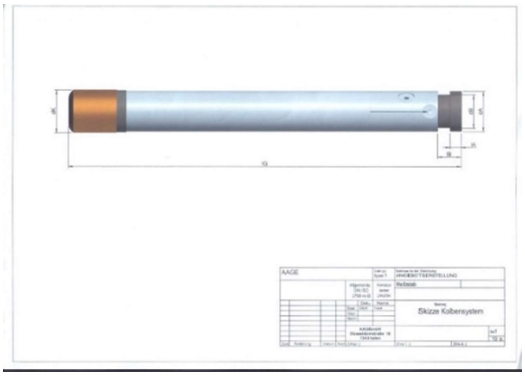
Aage GmbH is a development foundry working in die-casting. It was founded in 2004; and, alongside Arbeitsgemeinschaft Metallguss GmbH and the Europäische Forschungsgemeinschaft Magnesium e.V., offers over 30 years of experience in manufacturing die-cast parts from aluminium, magnesium, and zinc.



The ThinKing in Video

In our new video series "**Leichtbau leicht erklärt**“ we present you the ThinKing within a few seconds: https://youtu.be/26jDmoQm8Xo

Images (printing free of charge):

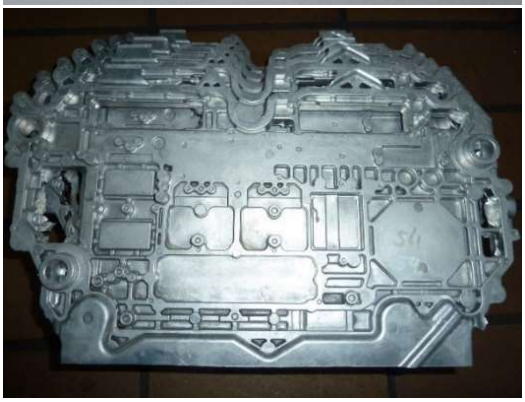


[ThinKing_Aage_Image-1a.jpg]
Casting piston rod: The casting piston is shown on the front left side, which transitions into the casting piston rod made of an aluminium alloy.

Image: Aage Aalener Gesellschaft für Leichtbauteile GmbH

[ThinKing_Aage_Image-1b.jpg]
Casting piston rod: The casting piston is shown on the front right side, which transitions into the casting piston rod made of an aluminium alloy.

Image: Aage Aalener Gesellschaft für Leichtbauteile GmbH



[ThinKing_Aage_Image-2.jpg]
Die-cast component with complex moulds and a high dimensional tolerance, weight around 2 kg.

Image: Aage Aalener Gesellschaft für Leichtbauteile GmbH

[ThinKing_Aage_Image-3.jpg]
The mould must be filled with 220 litres of metal melt per second for the gearbox housing. Burr formation is reduced significantly, particularly in the dividing plane,
with a casting weight of 39.5 kg.

Image: Aage Aalener Gesellschaft für Leichtbauteile GmbH

[ThinKing_Aage_Image-4.jpg]
Casting piston rod to manufacture the gearbox housing with a 200 mm diameter.

Image: Aage Aalener Gesellschaft für Leichtbauteile GmbH

[ThinKing_Aage_Image-5.jpg]
Die-cast part free from burrs and defects, consisting of ten wings and two hub halves, cast without reworking, total weight 42 kg.

Image: Aage Aalener Gesellschaft für Leichtbauteile GmbH

Editorial contact:

Your contact person at the Baden-Württemberg State Agency for Lightweight Technology

Carina Konopka
Manager Communication
Breitscheidstraße 4
70174 Stuttgart
Tel.: +49 711 – 128 988-44
Cell: +49 151 – 1171 10 02
Carina.Konopka@leichtbau-bw.de
www.leichtbau-bw.de