

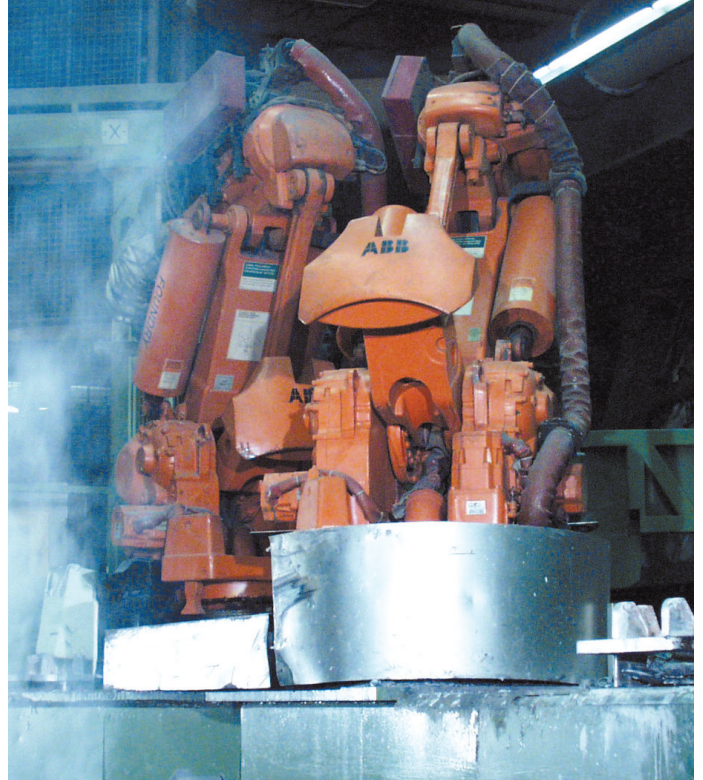
## Casting in perfect harmony at DaimlerChrysler Case study: 4000 cylinder heads per day with 4 robots

Four robots carry out complex casting applications at DaimlerChrysler's light alloy foundry in Mettingen. The IRB 7600 dips its ladle into the molten aluminum and takes out a precisely measured amount of the liquid metal. At exactly the same moment, a second IRB 7600, which is installed directly next to the first one, pours the contents of its ladle into a cavity mould that is moving past on a conveyer.

At exactly the same moment, a second IRB 7600, which is installed directly next to the first one, pours the contents of its ladle into a cavity mould that is moving past on a conveyer. When the next mould arrives on the conveyer, the robots switch tasks. Despite their extreme proximity to each other, the two power robots work in perfect synchronization.

We are at the foundry at DaimlerChrysler in Mettingen, near Stuttgart, Germany. One of the largest light alloy foundries in Europe, it produced around 25,000 metric tons of gravity casting and 24,000 metric tons of die casting in 2004. For Ralph Koppenhöfer, who is in charge of the light metal cylinder head No. 2 foundry, having your own foundry is indispensable as a car manufacturer.

"We don't just develop the parts and make prototypes," he says. "We want to actually produce them ourselves, because that's the only way to build up knowledge." ABB robots are involved in many of the key processes – core handling and casting as well as cleaning the final castings. "We started with ABB when we first got into robotics," Koppenhöfer recalls. "We installed our first robots in the core assembly. Then, working with ABB, we developed the foundry robot." DaimlerChrysler also opted for ABB robots – the IRB 7600 with a handling capability of 400 kilograms – when it converted the



foundry production for robot use in late 2004. At the center of this installation is a conveyer with 12 casting stations on which cylinder heads are cast for both Mercedes automobiles and for light commercial vehicles.

The K12 installation stands directly next door, itself converted to robot use two years ago. Two IRB 6400 robots are at work here. These have a handling capability of 200 kilograms; otherwise the two installations are identical. Albrecht Gruner, of the foundry's planning department, explains the development of the robotic solution: "We'd made inquiries at ABB about our conversion plans. The challenge was to keep the conveyer moving during the whole production process. That's unusual, as most conveyors stop and start. The robots would have to imitate the movement of the conveyer". Many simulations were run at ABB in Friedberg before the right solution was discovered.

Conveyor tracking was the key to the best solution. The circular tracking in Mettingen is achieved through an incremental encoder drive with two transducers. ABB engineer Dirk Hablick explains the principle:

# Casting in perfect harmony



“We receive the data for the movements required through a small cog wheel that connects into the conveyor’s drive. The robots are connected electronically to the conveyor. If the encoder turns quickly, the robot program runs proportionally quickly to keep on track with the conveyor. If it stops, so does the robot. The robot is able to imitate movements to within two or three millimeters.”

The limited space available to house the robots demanded an innovative solution. The robots were replacing a gantry robot that used to place the ladles into the moulds.

“We already had the conveyor and the industrial furnace,” explains Albrecht Gruner. “We had to find space between these for the robots and make sure that even if they overlapped each other, they didn’t get in each other’s movement space. Under the old system, all the machinery had to be fine-tuned to cope with just one type of cylinder head, which made us very inflexible. With the robots we can use this installation for every type of cylinder head.”

A conveyor system feeds core packages to the ladling carousel. The sand cores are placed in the moulds by a special machine. The next stage is the casting process, which is carried out by the two ABB robots. The individual robot is given the relevant parameters for the particular type of cylinder head that is next in line. These come through the conveyor, where all the data is available. The robot then loads the corresponding program and carries it out.

The two robots share one industrial furnace. While one is scooping up aluminum, the other is pouring the metal into the mould and vice versa. This way they are able to maintain a 30-second rhythm. After the metal has been poured, it is allowed to cool for 220 seconds inside the closed mould. The casting is then taken out of the mould and allowed to cool further.

## ABB Robotics

[www.abb.com/robotics](http://www.abb.com/robotics)

The two installations produce roughly 2,000 cylinder heads a day. In all, 17 different types of cylinder head are produced. There are usually four or six types in production at any time. Each type may have a different casting weight. “The weight varies between 26 and 35 kilograms,” says Markus Schwarz, who is responsible for the conveyers in Mettingen. The high precision that is demanded when measuring the molten aluminum is provided by a complex system designed specifically for the ladle.

The decisive factor for Ralph Koppenhöfer in choosing which robots to invest in is how well the system actually works. “We want a system supplier with know-how,” he says. “One of the key criteria was finding a supplier who could do everything on its own. That’s where ABB trumped the others.”

Onsite service is of equal importance. ABB has a member of staff permanently deployed at the DaimlerChrysler works at Untertürkheim who is responsible for all the related plants in the area, from Bad Cannstatt to Mettingen. Says Koppenhöfer: “By deploying someone here, ABB has done a great deal for onsite service. That’s very important. Someone whom we can turn to at the drop of a hat, that’s irreplaceable.”

ABB supplied the two casting plants not only with the robots and their associated grippers, which were developed jointly by ABB and the Austria-based Fill GmbH, but also the robot software, the personal computers to serve the robots, and engineering as well as start-up support. ABB also helped with construction of the bridge on which the robots stand.

Koppenhöfer says he is especially impressed by the robots’ user-friendliness and strength. He’s also very complimentary about the contribution made by all the ABB personnel. And he’s very taken with the technical competence of the robot specialists. “Everything fit perfectly,” he says.

## Why robots?

The use of robots in casting applications has a number of advantages:

- Greater flexibility than with gantry robots as mechanical coupling is unnecessary
- User-friendliness
- Ability to operate in narrow spaces
- Flexibility to operate with different types of cylinder head.

## DaimlerChrysler Mettingen foundry at a glance

Mettingen, Germany, is the site of the light alloy and cast iron foundry for DaimlerChrysler. The product range of light alloy castings includes cylinder heads, the camshaft drive housing, crank cases, oil sumps, subframes, engine mounting and gear boxes. The annual capacity of the light alloy foundry is approximately 25,000 metric tons of gravity casting and 24,000 metric tons of die casting per year.