

Foundry automation with the help of robots

Foundries make exceptional demands on the design of automation equipment. ABB Flexible Automation, with more than 25 years of experience in a wide range of industrial areas, has developed robots especially for use in hostile foundry environments. Currently, over 3,000 ABB robots are employed in foundries throughout the world.

The robot-based automation of casting in foundries, besides increasing productivity and helping to ensure a consistently high product quality, has also been a major force in the further development of the casting processes. The newer foundries, particularly those making aluminium parts, have introduced innovations which are causing the industry to rethink many of the processes on the shop floor.

The installation of industrial robots offers foundry operators a wider range of options, translating into greater flexibility and shorter times for changing over to new parts and products.

The growing importance of cast aluminium parts

A growing interest in aluminium is being shown in particular by the automotive industry, since the use of this lightweight material, by lowering the weight of the vehicles, helps to reduce fuel consumption. Another goal achievable with aluminium is trouble-free recycling. Considering that about 40 million motorized vehicles are produced each year, this can help to lessen the environmental impact of scrapping vehicles.

Whereas automated, robot-based die casting of aluminium parts is well established **1**, the use of robots in sand casting foundries has only taken off in recent years. Approximately 60 percent of ABB foundry robots are currently being used for die casting, while only about 10 percent are used for sand casting.

ABB industrial robots for a wide range of applications

ABB Flexible Automation offers industry a wide range of robot models for many different applications. Several of the models have an 'F' attached to their type series number to signify that they were developed especially for use in foundries **2**. The joints of these robots are especially well protected, as are the more sensitive working parts, which are fitted with additional seals to keep out fluids and dust. These measures ensure that the hostile environment cannot impair the repeatability of the robots. ABB robots are designed

to protection classes IP55, 66 and 67 as per DIN 40050/IEC Publ. 529. High availability is ensured by a mean time between failures (MTBF) of 40,000 h.

Purpose-built robot wrists

The wrist of a robot is the hardest-worked part of the robot's arm, and in foundries often comes into contact with mould sand, sprayed liquids and hot castings. A special wrist therefore had to be developed that would be capable of withstanding dust, vapours and high temperatures **3**.

Robots for handling and assembly in the moulding shop

Casting in sand moulds is a growing sector of the foundry industry. A drawback of sand moulding, however, is that the moulds can only be used once, each new casting requiring a new one.

Sand moulds usually have several parts and can be heavy, which makes them difficult to handle. What is more, the current trend towards larger castings is increasing both the complexity and the size and weight of the moulds. Hitherto, the use of robots in the production of sand moulds has been very limited.

The development of robot-based systems capable of producing sand moulds efficiently is a fast-growing area **4**. This is because the method traditionally used to manufacture sand moulds, involving a large number of assembly tasks plus the lifting and handling of core pieces, makes it ideally suited for automation based on a combination of articulated-arm and gantry robots.

To date, ABB has supplied more than 300 installations in which robots assemble and handle the sand moulds as well as post-process the castings. The versatility of the robots is utilized best when multi-stage production cells for multiple operations are installed. This also improves the economic efficiency of the installed system.

Sven Sjöqvist

ABB Robotics Products

The trend towards aluminium engine cylinder blocks and heads as well as car wheel rims has resulted in a strong growth in demand for aluminium castings. 1

Robot-based aluminium foundry at Ford Windsor

One of the most advanced fully automated aluminium foundries in the world is located at the *Ford Windsor* plant in Canada **5**. Employing over 100 gantry and articulated-arm robots from ABB Flexible Automation, the plant uses a low-pressure sand casting process to produce cylinder blocks and heads for different sized engines. The production capacity of the plant is about 1 million engines per year.

From the start, a high priority was given to good working conditions, headed by safety and environmental cleanliness. The production lines provide maximum flexibility for easy, low-cost adaptation to changes in the production requirements.

The shop in which the sand moulds are produced is divided into two units, one dedicated to blocks and one to heads.

Maximum flexibility is ensured by a production line with 38 identical cells. Each unit can produce, fully automatically, 60 sand moulds per hour and is equipped with a system for fast tool change.

Automatic mould assembly

Each mould core is produced in a special machine. The complete mould, mounted on a pallet, is progressively built up as the pallet is transported on a rail car through the robot cells **6**. A finished sand mould, eg for casting a cylinder block for a three-

Product range of ABB Flexible Automation. An 'F' added to the type series number of purpose-built robot models signifies that they have been developed for use in hostile foundry environments. 2





3 *Special wrist of a robot developed for applications in foundries. It can withstand mould sand, dust, sprayed liquids and high temperatures.*



4 *A robot being used to manufacture sand moulds for casting aluminium parts*

liter engine, consists of 18 different-sized parts and can weigh up to 200 kg.

In all, there are 90 IRB 6000 robots installed in the production cells. Each core

shooter is tended by a pair of articulated-arm robots working either independently or in tandem. Each robot removes cores from the machines, stores and retrieves

cores from buffers, inserts cores into the assembly and applies adhesive. All the staff have to do is supervise the operation of the production cells and check the

5 *Aluminium foundry at Ford Windsor, Canada. The foundry is one of the most advanced fully automated plants of its type in the world. More than 100 articulated-arm and gantry robots from ABB Flexible Automation produce cylinder blocks and heads for a range of Ford engines.*



finished mould parts. Each of the operators is responsible for two production cells.

Gantry robots help with post-processing

The fully assembled mould is transported by rail car to the foundry **7**, which is also divided into two units – one each for the cylinder blocks and the cylinder heads.

Nine gantry robots handle the fully assembled moulds and castings. One IRB 8700L robot lifts the moulds from the pallet and carries them to the casting station. The empty pallets are transported on the rail car back to the moulding shop.

Two gantry robots equipped with two independently controlled heads handle the cylinder block moulds, while a third gantry robot with just a single head handles the cylinder head moulds.

After casting, an IRB 8700A gantry robot places the moulds plus castings onto pallets, each of which has space for six units. This robot is equipped with three independent heads, each capable of carrying 700 kg.

The pallets are transported to the next station, where the castings are cleaned. Here, another gantry robot lifts the moulds from the pallets and places them on a conveyor that passes through a station in which the mould sand is removed. Afterwards, the castings are heated to burn off the sand bonding additives. The sand falls off the casting and is recovered for recycling.

An IRB 8510A gantry robot takes the cleaned castings from the oven to the post-processing machines **8**. Three IRB 8510L gantries transport the castings between the machine tools and the buffer store.

ABB know-how in all areas of foundry automation

Two decades of working closely with customers and other ABB companies has



Assembly of sand moulds at Ford Windsor, Canada. The mould assembly is progressively built up on a pallet, which is transported on a rail car to the robot cells. **6**

Sand moulds weighing up to 200 kg are transported on pallets in the foundry. **7**



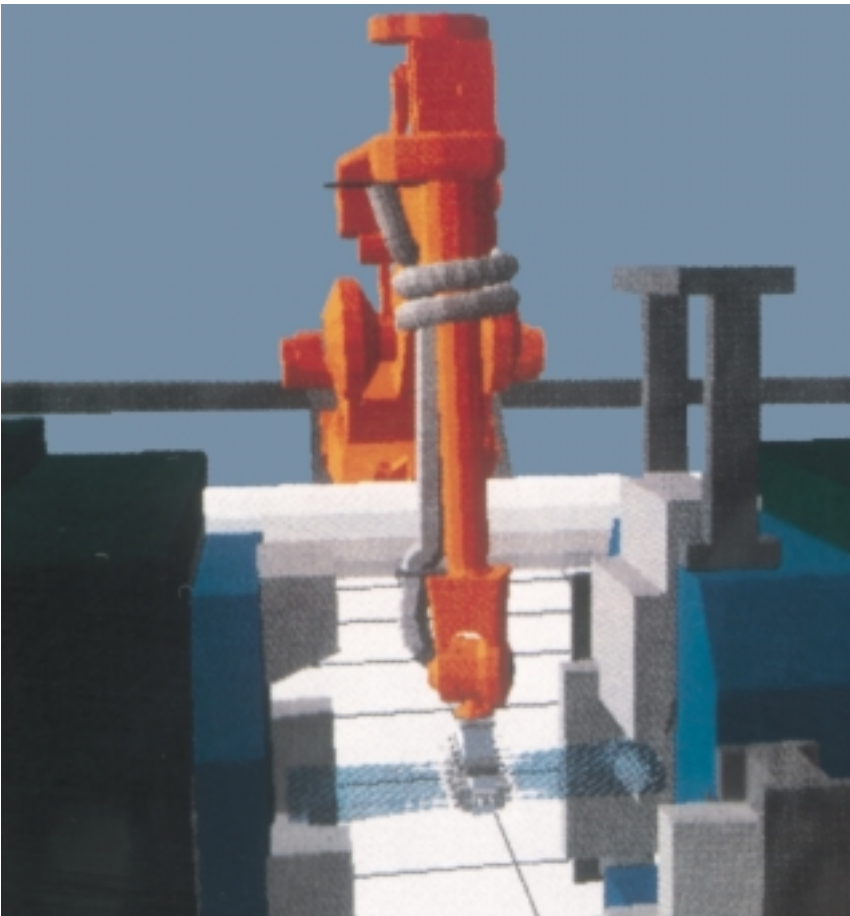


Robots are highly versatile and can be easily reprogrammed to carry out a new operation, such as deburring.

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The latest foundry application revolves around an IRB 4000 robot with an extended articulated arm, purpose-built for spraying lubricant on dies for die casting. The robot is mounted on the top of the die casting machine. A special nozzle fitted to the wrist can reach all surfaces of the tool.

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enabled ABB Flexible Automation to accumulate know-how spanning the entire field of foundry automation 9. This know-how is based on the experience gained over nearly 30 years with in-house applications. The first in-house installation of a robot, for producing of the aluminium cage rotors and stators of electrical machines, dates back to 1969.

With its broad experience of industrial processes and automation as well as its local presence worldwide, ABB is ideally placed to plan and supply production plant for foundries.

ABB Flexible Automation is today the leading supplier of five-axis and six-axis industrial robots to the foundry industry. In all, ABB robots help to produce approximately 6 million aluminium parts every year.

Outlook

Market analyses have shown that demand for aluminium castings is likely to grow by an average of more than 200,000 t per year over the next decades. Annual production in 2010 is expected to exceed 10 million tonnes, meaning that more than 20 new foundries will have to be built every year until then in order to meet the growth in demand. The foundry industry is currently in the process of restructuring itself and aluminium producers are increasingly integrating themselves into the manufacturing of finished parts for industry.

Robot-based production is expanding rapidly within the foundry sector, with a total market requirement estimated at almost 5,000 robots per year.

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