

Going behind the scenes with Conrad

Steven Downes was one of a privileged few to be invited to take a tour round the Conrad factory in Kalchreuth, Germany, to find out about the inner workings of one of the world's best known diecast manufacturers.

Conrad began model production in 1956 and, over the years, the Conrad name has become well-known for its quality, attention to detail and functionality, using high quality materials and employee skills to bring every miniature to life. Located in the small village of Kalchreuth on the outskirts of Nuremberg, the factory houses the painting, printing, injection moulding, assembly, warehouse, spare part storage, offices and the showroom/museum.

While many other model manufacturers have moved production to China, Conrad is proud to continue the tradition of producing quality models in Germany and, while it is typically known for its range of construction, lifting and haulage models, these are not the only types of model it has produced over the years, with obscure projects including engine replicas, military vehicles, fire and rescue vehicles and even a 1/50 scale replica of a modular printing press showing the diversity.

Prototyping

In order to begin a project, a meeting takes place with the original equipment manufacturer (OEM) to gather the various technical details, drawings, photographs and CAD files of the item being modelled. The discussions highlight what the customer is looking for from the replica, which functional parts of the model need to be simulated and the timescales for the delivery.

Models can take anything from six to 18 months to create and most are required for



The main Conrad factory in Kalchreuth.

trade events and shows so keeping on track is very important, something Conrad is very well-known for, even hand delivering models on the day of an event to ensure customer satisfaction!

The real work begins with the production of a plastic hand sample, expertly created with the use of a computer controlled 3D stereo lithography printer. Gradually, the part takes shape and once completed, an engineer works on the parts, preparing them to be painted and decorated before assembling them to form a hand sample. At this stage, a follow up meeting with the OEM is arranged to discuss the hand sample.

All the functionality of the hand sample is assessed with engineers from the OEM scrutinising every aspect, including the dimensions, colours and decoration. It is at this point that changes and enhancements are discussed, where needed, before the time consuming stage of mould making begins.

Tooling

Once the prototype hand sample has been completed and approved, the tooling phase can start. This is performed in a separate facility about 7km from the main factory where the machining is performed and the zinc parts are cast.

The employees use their extensive experience and knowledge to lay out the parts for each mould using the latest

computerised software to ensure the molten material will flow into every crevice of the mould. The computer data is then used to begin the long process of machining the copper masters which are used later in the process to produce the final tooling mould.

Copper is used to allow the intricate details to be machined and this is performed by computer controlled milling machines which work 24 hours a day with cutting operations taking anywhere from several hours to well over a day on a single part.

For the repeated casting of the parts, each mould needs to be strong and it would not be possible to machine the steel using cutters as they would become blunt or constantly break which is one of the reasons why copper is used. The other reason is that the copper masters conduct electricity and are attached to a machine that uses electrolysis to gradually form an imprint of the part into the metal of the mould. This is done while immersed in a special oil formulation and as the copper master touches the steel, tiny explosions remove a small amount of metal. This process is repeated over and over until the pattern forms in the mould.

Casting

Several moulds are required for each model depending on the complexity and size of the



Machining of the main structural components of the mould is the first step.



The zinc casting area where all the metal parts are produced and stored.

finished piece. Once the moulds have been completed they are connected to the casting machines.

The mould is in several parts that open to allow the cast items to be removed. First, the mould is closed and the molten zinc is injected at high pressure into the centre of the mould where it flows into all the channels and voids within. Cold water is then flushed through cooling channels within the mould to rapidly cool the injected material enough for it to solidify.

The mould then opens after several seconds and pusher rods are deployed to eject the cast parts from the mould. Once cast, the parts need to be cut from the sprue and have the flashing removed. This is performed by adding the parts into a vibrating drum, filled with small abrasive stones. The vibrating motion removes all the rough edges from the zinc parts while some parts require manual cleaning in preparation for painting.

The plastic injection moulding is performed at the main factory with the moulds produced in the same way. Different formulations of plastic pellets and coloured granules are used to produce the required colours for the plastic parts and different



The electrolysis machine at work.



A worker carefully removes the fragile parts from the casting machine to prevent damage while the parts cool.

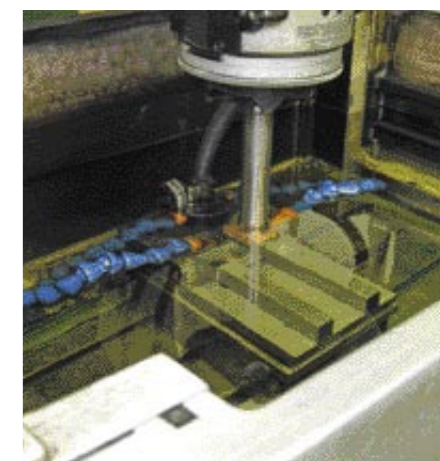
types of plastic are used – some hard, some flexible. Most models have windows and for these to be cast perfectly clear, the inside surfaces of the moulds need to be highly polished. This process alone can take several days.

Painting

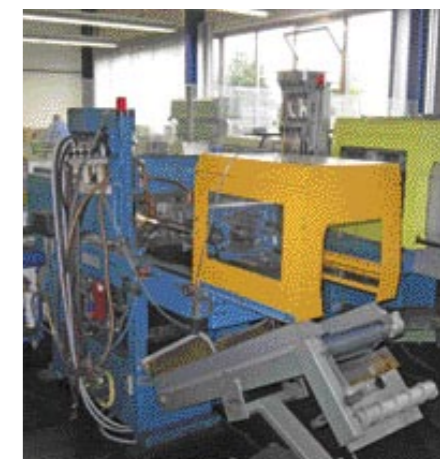
As the cast parts arrive from the casting facility they are transferred to the paint department where workers check each part before placing them onto metal trays. As each tray is populated, it is placed onto the continuous painting conveyor which slowly rotates, taking the trays through to the spray heads.

All the paints used by Conrad are water based and each change of colour requires all the heads and piping to be thoroughly cleaned. This can happen several times a day depending on the work load and colour combinations.

Within the paint bay, spray guns are mounted to a computer controlled framework travelling back and forth. A sensor detects the tray as it enters the opening, ensuring paint only flows when there are parts to paint, making the system economical.



A constant up/down movement of the copper master gradually forms the pattern into the steel.



There are four plastic injection moulding machines in the main Conrad factory.

The heads are positioned at different angles and heights to ensure optimum coverage of the parts as they pass by, with each spray head fully adjustable, depending on the size and shape of the parts being painted. The control panel allows numerous adjustments to be made, ensuring the spray pressure of the paint is perfect to prevent the small and light parts from being blown off the trays.

From the paint bay, the trays pass under a drying station where cold air is blown onto the parts as they slowly progress on their journey. The trays then pass under hot air blowers that begin the drying process. The exact time the parts remain in the dryer is a closely guarded secret, giving the parts a vibrant and durable finish before exiting the dryer onto a continuous conveyor.

The automated paint system is very effective for producing many parts of the same colour. However, with small parts that need painting in different colours, the parts are manually painted in a dedicated spray booth before being inserted into the dryer. Once the parts have been painted, those that need printing are transferred to the printing room while the remaining parts are stored ready for assembly.

CONSTRUCTING CONRAD MODELS



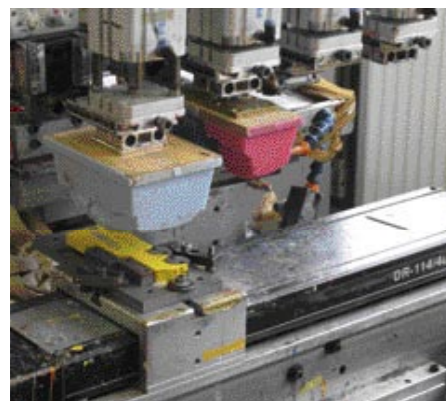
A worker monitors the pressures, making adjustments for a perfect paint finish.



Once the parts have passed through the drying ovens, they are turned over so that every part is fully painted.



Parts exit the paint booth ready for the next stage.



First stage, printing of the underlying artwork.



Second stage, printing the next colour.



Finished parts ready for assembly.

“Quality is a main factor at Conrad – and this is built into the entire assembly process with each operator checking for defects and errors from the previous stage while performing their part of the assembly”

Printing

Years ago, any artwork and decoration found on a model was applied with decals or stickers, which left a faint outline around the graphic. Care was needed to ensure the decals were not disturbed.

Moving with the times, the printing department at Conrad houses a state-of-the-art tampos printing machine that is capable of transferring up to 16 colours in a single pass.

The artwork for a model is designed from photographs and sign-writing diagrams to ensure all the details are accurate to the original. From this, the colours are separated and a plate is prepared for each individual colour. The design is etched onto the plate, the depth of the etching determining the amount of paint that will be transferred to the model.

Once the plates are ready, they are installed on to the printing machine. In one movement, all the plates are covered in paint before a blade scrapes away the excess, leaving behind only the required design.

Silicone blocks then press briefly against

the plates, transferring the paint before the entire assembly moves forward and contacts with the surface of the model being printed. The part moves along the line, as each colour is added to the last until all the colours are printed. Different densities of silicone are used to ensure the image remains crisp and in proportion, no matter what contours exist on the model's surface.

While the main printing machine is fully automatic, there are smaller single and twin colour printing machines that are operated by workers, holding the part to be printed against a jig to ensure consistent results on each piece. Single colour printing is typical for things like the black seals on cab windows.

A machine shop housed in the factory produces a number of assembly jigs and aids to make the tasks of printing and assembly easier. The machine shop is also equipped with an electrolysis machine so that small adjustments can be made in the tooling when issues arise with the assembly. Typical adjustments include any hole dimensions where the cooling process can cause the

holes on the cast part to be too small.

These problems are usually identified when the pre-production samples are produced so corrections can be made before production begins in earnest.

Assembly

Assembly begins once all the parts have been cast, painted and printed. Depending on the model being constructed, different stages are deployed. With truck models, the front steering axle is automatically assembled from the individual parts by a sophisticated automated system.

Picking up the parts, riveting them together, assembling the tyres onto the wheel rims and printing the hubs are all performed in the single operation with the final assembly dropped into a waiting box ready to be taken to the assembly line.

The engineers within the company have also designed and produced some ingenious rigs to automate some of the more simplistic but time consuming tasks, one example being an assembly jig that assembles and



Joining moving parts with rivets and hand presses.



Sub Assembly station.



Final assembly work station, assembling the Brechtel recovery truck from the various sub-assemblies.

THE FINISHED PRODUCTS

Mercedes Actros with Brechtel Recovery Body, one of the models being produced during my visit.



Limited edition Actros 4x4 in Arbogast company colours.



MAN TGS 10x4 with Liebherr HTM1204 Concrete Mixer Body.

Limited edition 1/50 scale Liebherr T282B Mining Truck in yellow.



pins each individual track segment from the cast pieces and a constant line of wire, a task which would otherwise take a long time to complete by hand.

The assembly room is divided into areas and it is typical for several different models to be assembled at the same time, starting with simple operations that result in a number of sub-assemblies that come together during final assembly. There are many specialist tools used during assembly with various hand operated and powered presses with different jaws and attachments, drilling machines, and hand tools all deployed. Glue is used sparingly to hold components securely with screws used for the final assembly.

Packing

Quality is a main factor at Conrad, and this is built into the entire assembly process with each operator checking for defects and errors from the previous stage while performing their part of the assembly.

Picking up issues early ensures that the

finished model meets the high expectations of the customer perfectly.

The final stage in the production cycle is the packaging, and each model is given a final inspection prior to being packed ready to be shipped out.

Different packing materials are used depending on the size and weight of the model, from the familiar foam lined cardboard packing to the polystyrene cartons and pre-formed foam inserts.

The spot check is another opportunity to ensure the models are perfect, with the production manager selecting several of the finished pieces and performing an exhaustive text, first checking everything is secure, running through all the functional parts of the model to check correct operation and finally tapping it on the desk to ensure nothing comes apart.

The model is then repacked and the finished models are transferred to the storage area prior to being dispatched to the customer.

Running a company the size of Conrad

requires additional support staff. The office area contains a meeting room where discussions are carried out with the customers while the main office houses the staff responsible for ordering the many parts and raw materials required for day to day operations, taking orders from model dealers and importers throughout the world and handling enquiries for after sales service.

The showroom is set up with numerous display cabinets, all holding examples of the models that have been produced over the years, a fascinating sight to see for those lucky enough to be invited.

With full order books for the foreseeable future and the factory running at full capacity, collectors can look forward to some interesting releases in the coming months.

I would like to give a special thanks to Conrad for inviting me to see the inner workings of the factory. The time spent there certainly left an impression on me and with all the hard work that goes into each and every release, I can now appreciate why the models cost the amounts they do. **DC**