

# Wooden moulds for glassblowing

Documentation of the manual craftsmanship

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**Kalmar County Museum**

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At Boda glassworks in the 1950s, mould maker Börje Franzén made all the graphite and wooden moulds, for various artists including Erik Höglund. Photo: Henrik Hultgren, 1954, The Glass Factory archive.



Older wooden moulds and other tools, from the collections of Kalmar County Museum. Photo: Maria Winsö, Kalmar County Museum.

# Introduction

Most of the glass blown in the glassworks in Småland is blown into wooden moulds, but also in graphite, metal and ceramic material. Since the glass mass reaches such high temperatures (at least 900 degrees C), it places high demands on the moulds. Soaked handmade wooden moulds made of alder wood have historically been considered to work best. For a long time, wooden moulds have been used for some production, while another product might best be made in graphite, depending on the model, design and size. Cast iron moulds have also been used. Historically, all glassworks had their own

woodworkers who made wooden moulds in their mould workshops.

Today this activity has ceased at all glassworks except Kosta. The process of making a wooden mould by hand can take between a couple of hours and up to a few days. A machine milled mould can be done in a couple of hours. A wooden mould can usually last for between 100 and 500 blows.

Gunnar Englund in Örsjö is today one of only a few craftsmen in the country who is a master in



Gunnar Englund in his workshop in Örsjö.



Gunnar's design workshop housed in an old barn in southern Örsjö.

the art of manufacturing glass moulds in wood by hand. Although the mould is such an important part of glass blowing, and often crucial for the finished glass to be of good quality, there is surprisingly little described about this process in literature. Even in larger volumes about glass and the Kingdom of Crystal, the focus has been on other aspects. This report describes, above all, the process and the working method for the craftsmanship of wooden moulds for glassworks. The documentation has been made possible thanks to a collaboration with Gunnar Englund.

The manufacture of glass moulds in wood, which previously took place within each glass factory, has largely disappeared due to the modernisation, closure and outsourcing in the Kingdom of Crystal. Today, there are only a few mould makers in the country, and new influx is rare. Currently, wooden moulds for glassblowing are manufactured at Kosta glassworks, at Jacobssons Mould Workshop in Hovmantorp and by Gunnar Englund in Örsjö, as described in this report. Since 2016, Gunnar also has an apprentice, Andreas Flink, a furniture maker from Källstorp.

MEJK Tools in Nybro also makes moulds, both in graphite and steel, for blown, cast and pressed glass, and Målerås casts its' own moulds in cast iron, from a plaster model, for their own use.

Gunnar previously worked at Orrefors glassworks. His master in Orrefors was Anders Karlsson, the head of the wooden mould workshop. In 1998 Gunnar started his own mould workshop in Örsjö. The workshop is housed in a converted old barn on his property.

Gunnar has taken ownership of some machines from various glassworks. There is a lathe from Åfors glassworks which he found on the scrap heap and a lathe from Orrefors glassworks which was bought secondhand by the factory in 1927, but which still functions. Gunnar also has several other tools that he has taken over or bought from the workshop at Orrefors. It takes an average of one day to make a wooden mould by hand. In this method, about 200 wooden moulds leave the workshop in Örsjö every year.



# Mould production in the Kingdom of Crystal, a history

In the past, all glass factories produced their own moulds as they were needed for mould

blowing. There was plenty of wood. Both the raw material and the workforce was cheap.

According to Kosta glassworks anniversary journal, it is stated that 'from the beginning (i.e. 1742) most of the moulds were made in wood'. At Rosdala glassworks many moulds were made in beech wood. Other types of materials for moulds have also been used historically, such as iron, brass, lead, clay and plaster."

## Iron Moulds

For larger production series, it was more economical to use cast iron moulds. Although these were much more expensive than the wooden moulds, they could be used for more blows. Among other glassworks, Kosta exported a lot of glass to England as early as the 1880s. The iron moulds that were used would have been smeared with crushed potatoes, and from the middle of the 1890s, with linseed oil, carbon or sawdust. Cork shavings were also used. They lubricated the mould so that the glass would not get stuck. Cast iron moulds were made at the beginning of the Twentieth century



Rosdala glassworks is one of Småland's factories that has a huge mould archive.

by, among others, Stenbergs in Emmaboda. William Stenberg came from a family of blacksmiths. He was born in 1885 in Brorsryd in St. Sigfrid's parish, but in 1901 the family moved to Lindås where his father P. A. Stenberg started Lindås foundry, later Flygt's Pumps, and today Xylem. One of the products made by the foundry were moulds for pressed glass. By this route, William came into contact with glass. He began to manufacture both pressed glass and blown glass in his own designs at the glassworks in Transjö. When the chance came to run his own glassworks, he bought Gullaskröv factory, with his partner, restaurateur Carl E. Johansson, where Stenberg became the manager.

## Wooden Moulds

With the lathes that Gunnar has access to, there are limitations as to how sizeable moulds one can produce, as it has also been historically. When it was necessary to blow really large glass objects in the past, such as substantial lamps, you could use what's called slats or rib shapes (which were suitable for rotating blown glass, where the glass is spun consistently). They were made of narrow wooden ribs set at intervals. Some such older moulds are preserved, for example in Pukeberg and Rosdala. Jacobssons Mould Workshop can produce moulds that are up to 1 meter in diameter, in solid wood. Here, the limitations are placed onto the glass blowers and how large the pieces they can blow.



An old cast iron mould from Rydefors glassworks is another example of preserved moulds left at many of the disused glassworks in the Kingdom of Glass. Materials that do not hold liquid – such as graphite and cast iron – must have a thin layer of a substance that can absorb water. Lubrication is done by brushing the surface with something sticky (e.g., linseed oil, but some use boat lacquer) and then fill the mould with carbon or cork powder. After a while you empty the mould after enough of the powder has stuck on the sticky surface. Ceramic material does not need to be lubricated. Also, moulds used for non-rotating blown glass are not lubricated – as they become “watery” anyway. The thin layer of steam that forms between the inner wall of the mould and the glass itself is what polishes the surface of the glass – but the polishing only takes place when you spin the glass in the mould. If you blow glass in a lubricated, non-rotating mould the result will be “watery”.



Slat or rib shapes were used in the past to blow very large glass vessels. These moulds belong to Pukeberg.



A wooden mould that has been carved out by hand is smoothed with a knife. Picture from the 1950s. The angle of the air channels indicates that the shape is a small bottle. Photo: Jan-Erik Anderbjörk, Smålands museum.



Gunnar Englund working on a wooden mould at Orrefors glassworks in 1998. Photo: Per Larsson.

# Wooden mould manufacture, the process

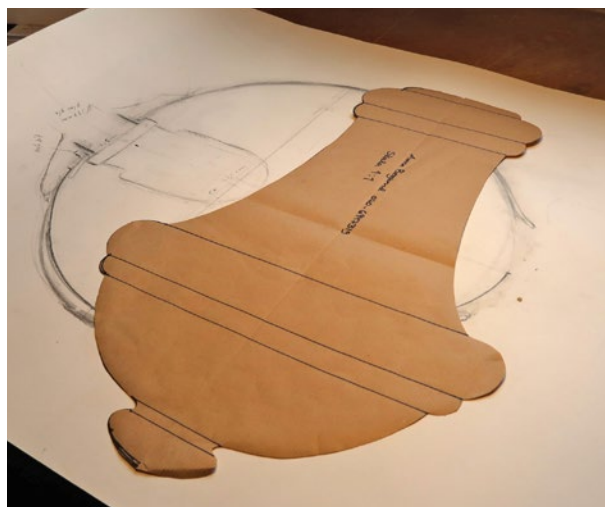
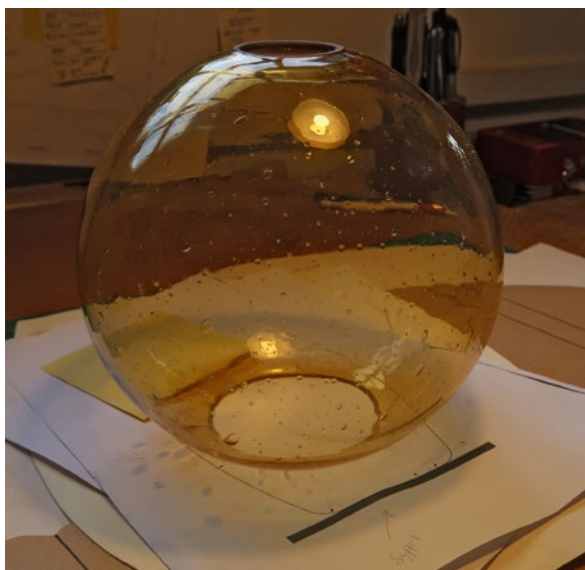
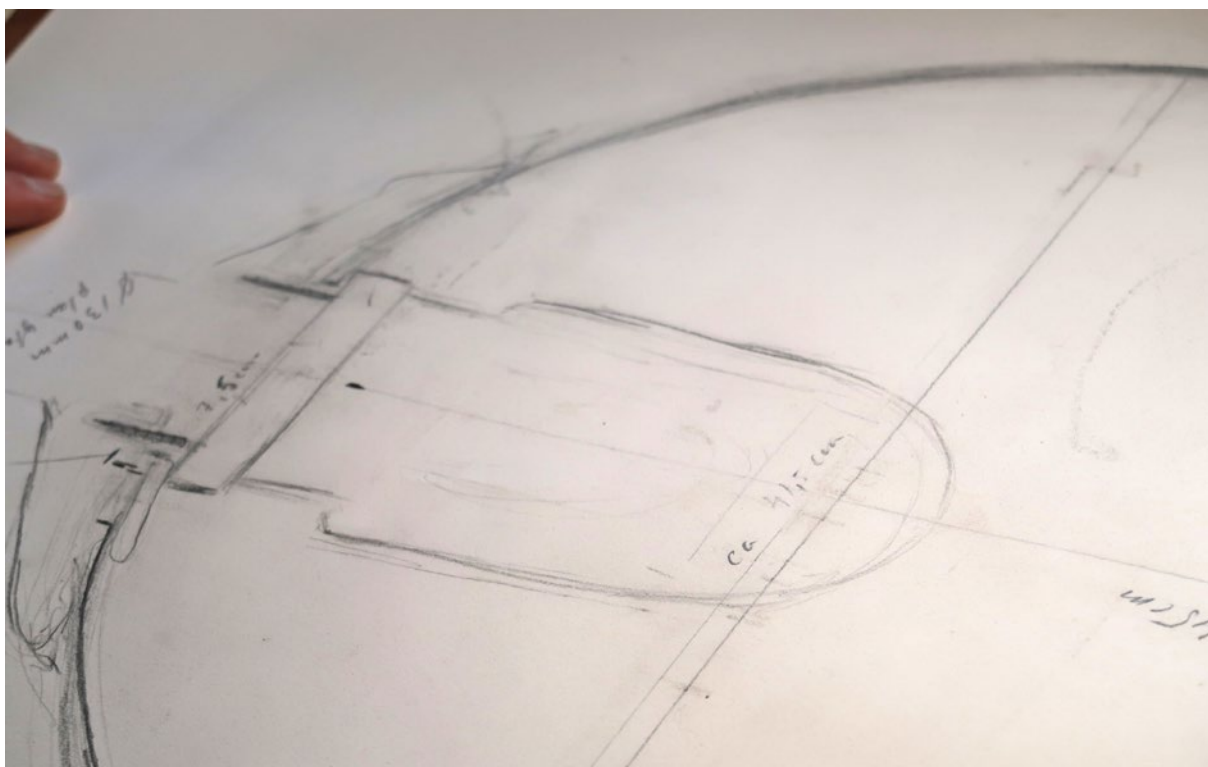
## Bases and templates

An order from a glassblower, factory or studio comes to Gunnar as a measured drawing, a sketch or sometimes as a finished glass object. The mould can be for a newly manufactured glass, a prototype, or an older glass that is to be reproduced (for example, lamps from a community house, hotel or other public premises). If the order arrives as a glass object, Gunnar must transfer it to a template. For this he uses, among other things, a tool called a “Horse”. In Gunnar’s workshop, there is a template collection from many different glassworks and studio workshops.”

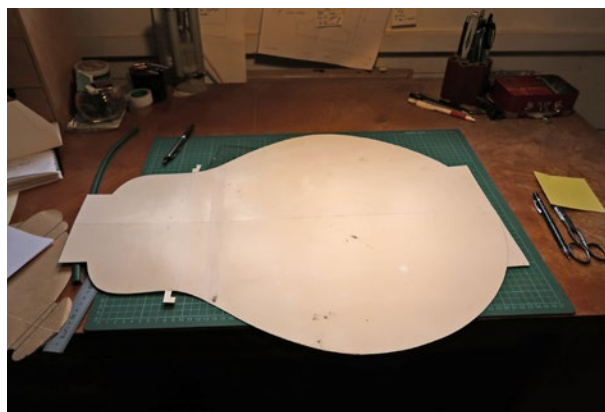
The “horse” is a wooden stand where the glass is clamped for drawing and transferring to a two-dimensional template. The curvature of the glass is followed by a contour tool, where the profile is transferred with a stylus to the template board. During this process, Gunnar is using cardboard as the template. Gunnar has a dialogue with the client so that all can agree on how the mould will be used and how the object is to be produced, for example, if a glass piece is to be overblown and cold finished or opened on a punty. When the template is finished, it is time to cut the wood.



Part of the template collection in Örsjö.



An order for a new wooden mould is made using a sketch, a drawing or with a glass object as a model. The round globe is a lamp that will be blown at Målerås glassworks. It has been commissioned by a parish hall in Stockholm.





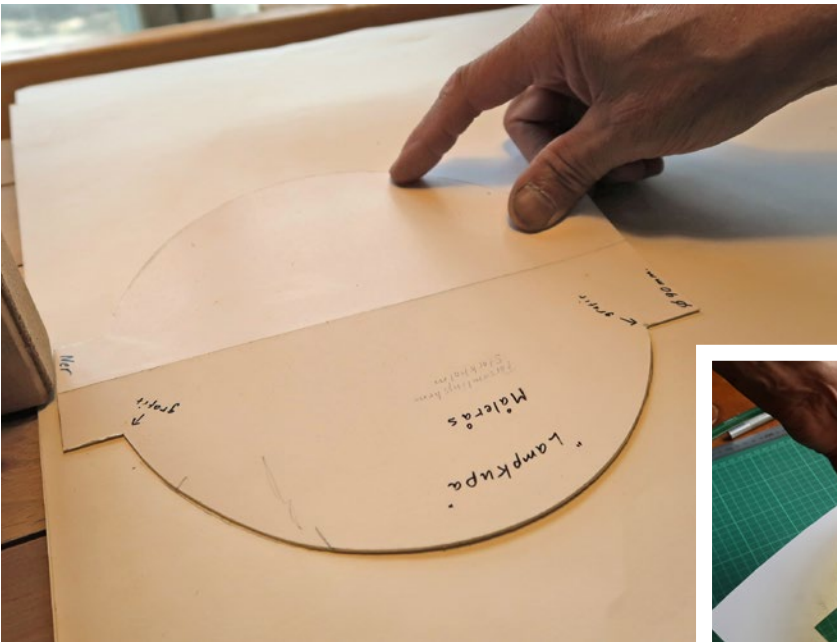
In the "Horse" the glass object is clamped firmly in order to be copied exactly.



The curvature of the glass is followed by a contour tool, where the profile is transferred with a stylus to the template board. When the wooden handle is pulled across the surface, an attached pen transfers the shape of the glass to the paper.



Profiled and leather-clad boards with slip paste for honing and sharpening cutting tools.



The finished template.



The original fits perfectly into the hole left by the template.



## Choice of wood

The wood used in the moulds must be able to absorb water well so that it can withstand at least 900 degrees of hot glass mass without immediately burning up. It must be free from knots and must not contain a resin that is found in conifers and oak, for example, which can discolour the glass. The wood species commonly used are:

- **Alder** – stable, meaning that moulds of alder can be left to dry out but if they are boiled they will regain their original shape. Swedish alder has an outstanding ability to suck up and maintain water, which makes it extra suitable for this purpose. (On the other hand, it is said that American alder will not work, because it is more porous and therefore not suitable for mould blowing.)
- **Swedish Whitebeam** – similar to alder but not as stable. Hard to find in Sweden.
- **Beech** – hard and extremely heavy. It easily cracks if left to dry. Used a lot in Germany.
- In southern Europe, usually fruit trees such as **cherry** and **pear** are used.
- In the US, most often **cherry** wood is used.

The wood used in the mould making process must be fresh or moist at the time the mould is made and kept moist during the whole process. If the wood is too dry while the mould is being produced, the contour will change as the mould is then soaked, and the glass will not form the desired shape. It is therefore not ideal to purchase too many logs at once, as they risk drying out. When Gunnar has the dimensions of the mould to be produced, an appropriate part of a log is selected from the kept stock. Gunnar primarily uses alder. The selected piece is cut off with a chainsaw. Because knots burn slower, there must not be any knots inside the mould. During production, it is therefore important to keep track of which direction the knots grow. To do this, the top is always marked with a cross on the log. The bark is removed with an axe.



The storage of alder needs to be watered during the summer months.



Gunnar chooses a knot free and moist part of a log, and saws out the required amount for the next shape.



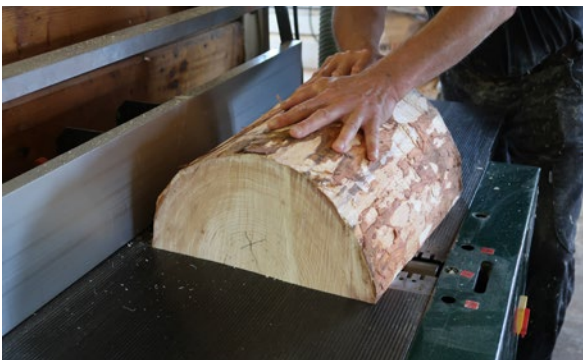
To keep track of the direction of the grain, in order to avoid knots in the mould, the top is always marked with a cross.



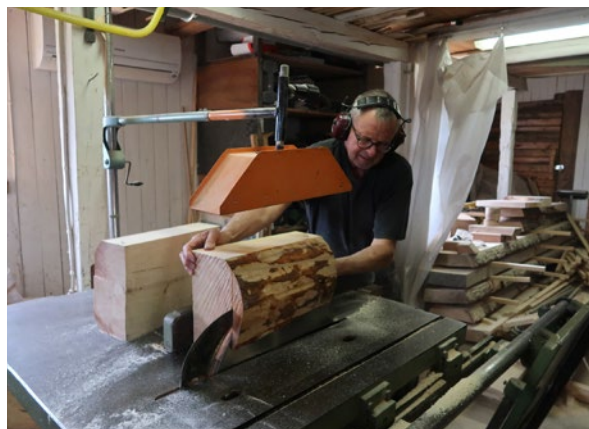
Gunnar removes the bark with an axe.



Gunnar divides the piece into two equal parts, using the circular saw.



The outer edges are smoothed on a surface planer.



The opposing edges are sawn as well.



Boring is underway to achieve the internal shape, the void that is formed when the mould is finished. Photo: Andreas Flink.

### **Sawing and dividing**

On the circular saw and planer, the piece is processed and divided into two halves. They are preferably made from the same log, as the goal is for a homogeneous material, to achieve the same reaction in the different parts of the mould in relation to varied moisture ratios.

### **Turning the right shape**

The two halves are nailed together and mounted on the back plate of the turning lathe. A needle is attached to the top slide as is adjusted according to the template, which is fastened to the edge of the lathe. The pointer makes exactly the same movement as the tip of the turning steel. The two lathe handles crank simultaneously. The right-hand cranks affect the top slide lengthwise, for-

wards and backwards relative to the placed block in the back panel. The second crank, which the left-hand drives, in turn, affects the cross slide. The movement of the cross member determines the internal diameter of the mould. Oval moulds are usually cut out with help from the band saw, and then cut with a gouge (a chisel with rounded or angled edge profile, see picture on page 24) and cut with a hook knife.

Sometimes the mould may need to be made in several parts, with hinges, so that the glass blower can easily get the glass out of the mould, without the glass getting pressed inward or sticking. This is required especially when the design of the glass is complicated and irregular in shape.



Andreas Flink blows out shavings during the turning. Photo: Gunnar Englund.



Different turning irons are stored in stands.



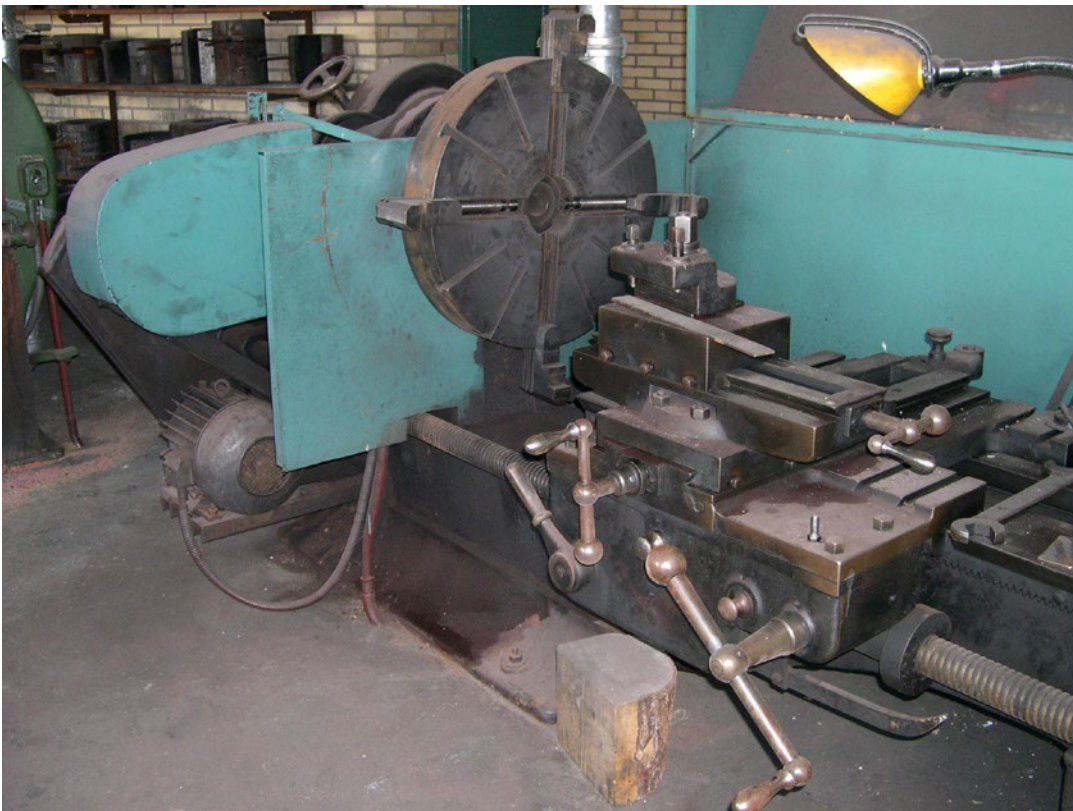
A new wooden mould for vases opened on a punty, was reproduced for "Vase Nr. 2", designed in the 1930s by Josef Frank for Svenskt Tenn. Since the glass has such a high indentation in the bottom of the vase, the shape is divided into 3 parts, in order to get the glass out after it has been blown. Photo above: Svenskt Tenn.



A mould for a cold cut opening. After turning, you can check that the mould matches the template.



The old lathe from Åfors glassworks is now used in Gunnar Englund's workshop in Örsjö.



Lathe at Rosdala glassworks. Photo: Gunnar Englund.



Another old lathe from Orrefors glassworks used in Gunnar Englund's workshop in Örsjö.

### **A personal reflection from Gunnar Englund:**

“Much of the machinery from Orrefors and their wood workshop was sold when the glassworks were closed down. In order for the lathe not to end up with someone who did not understand its value and history, it was rescued by Anders Karlsson and Åsa Jungnelius and was stored for several years at The Glass Factory in Boda, until Anders and I, were given the role by Maja Heuer for the use and care of it in my workshop. Anders and I consider it a responsibility to ensure that it is managed and maintained and that it also

continues to have a purposeful life after we have made our last moulds. This can be compared with an instrument, perhaps a Stradivarius, which is passed down through generations of musicians. The lathe, which we have come to call “Old Bettan” has, after all, followed Orrefors, through the whole, fantastic story. Its throbbing strap has been like a heartbeat that delivered vitality to the works and produced countless moulds, both test and production, for Gate, Hald, Landberg, Lundin, Cyrén and young and old designers who, over the years have come down to the mould workshop, with their drawings and sketches.”



Gunnar smooths the surface with a hand-forged hook knife. The work requires patience and calm and is an important, meditative part of the profession.

## Smoothing

After turning, there are still irregularities in the wood and therefore the inner void is filed to make it as smooth as possible. Since the wood is moist, sandpaper cannot be used, which, due to the moisture, would quickly disintegrate and become unusable. The finetuning of the surface is instead done with sharp cutting tools, spoon and hook knives. Finishing and smoothing the

mould halves can take minutes or hours, depending on the size of the mould and the complexity. Gunnar's tools have been manufactured by the blacksmith Rune Månsson in Lyckeby, who worked at the Karlskrona shipyard. These hook knives and cutting tools regularly need to be sanded on the grindstone and are groomed on a length of leather with a slippery paste to maintain their razor sharpness.





Cabinet with various gouges, spoon and hook knives for smoothing the moulds.



Gunnar shows a finished mould with air holes in both halves and air channels, which are made in only one half of the mould. (see arrow).

### **Air holes, air channels and mounting**

When the glass mass is blown into the mould, hot steam is formed. To release this steam, drilled air holes and a number of air channels are cut into the mould. If not put in, the glass surface will be-

come uneven, with a “watery” look. The edges of the mould are also bevelled off. The two mould halves are assembled with hinges and in some cases handles are also mounted on the mould.

## Delivery and the moulds' life in the workshop

Sometimes the mould is stored in water before it is delivered. For the wooden moulds to retain the shape and be constantly moist, they are delivered to the blowing workshop wrapped in plastic bags. This is usually not a problem in the Kingdom of Crystal or within Sweden but can become problematic in deliveries abroad. If the transport takes too long, the moulds may start to develop mildew.

Before the wooden mould can be used in the glass workshop, the surface of the mould is burnt until it is charred and thus sealed. Then the mould is kept wet until it is to be used. When the mould is delivered, it is in the same size as the prototype, drawing or model. With continued usage, the void becomes a little larger due to burnout. Wooden moulds are used both for glass that is to be sprung or hot popped and for glass that is completed in the workshop with a hand opened edge at the top. The length of time a wood mould lasts depends on the shape of the glass. If there are sharp ridges inside the mould, these will burn out faster than if the contour is smooth. The length of time that the mould is used also depends on how tolerant the glass manufacturer is with the shape being enlarged as the mould is used. The durability, therefore, varies quite a lot. It is usually between 100–500 blown pieces, which is not much. This is also the reason why many glassblowing moulds today are made in other materials, such as graphite and ceramic material, which are more resistant in shape and do not change size. With proper care, such moulds last “forever”. Graphite and ceramic material, however, has the disadvantage that it cools the glass slightly when you start blowing. It is usually no problem when blowing smaller or normal sized objects. When working with larger objects and unusual designs, this can affect the glass blowing. In this case, wooden moulds are usually better, as they cool less.



In the old milk room, a trough is used to soak moulds so that they do not crack.



Before the wooden mould is to be used in the glass workshop, it is burnt out, i.e. one burns off the mould's surface so that it is charred and thus sealed. Photo: Gunnar Englund.

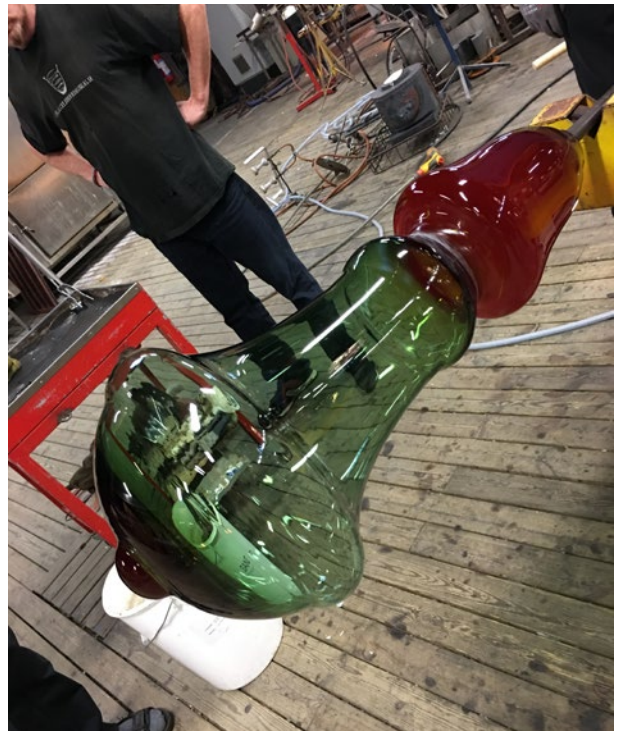


### Other glassblowing tools manufactured in the workshop

The wooden mould maker traditionally also manufactures other tools in wood for glassblowers, such as shaping blocks, paddling boards, footing tools and overlay tools.



Gunnar manufactures various tools in wood for glass blowers. Here, from top to bottom, there is a so-called "Pisselisa" for cooling of glass blower pipes, paddling boards, mould board, blocking tool and overlay tools such as overlay tongs and overlay jacks.



The pictures demonstrate how Micke Johansson, Svante Decker, Lars Axelsson and Magnus Carlsson from the team at Bergdala glassworks blow an object that will become a crystal chandelier. Notice the steam that is formed during the blowing. It is the key to the unsurpassed lustre on the surface of glass blown in wood. The secret is that the glass never touches the mould itself, but instead is stopped by a thin layer of steam. This mould is made in Gunnar Englund's workshop in Örsjö. The designer is Anna Berglund. Similar larger pieces hang as a public artwork at Lexhuset in Brussels. Photo: Anna Berglund.

# The Mould maker profession



Anders Karlsson on an occasion where he helped in Gunnar Englund's workshop. Photo: Gunnar Englund.

## What is it like to work as a mould maker?

Gunnar Englund worked with the manufacture of wooden moulds at Orrefors for seven years and has since 1998 been in Örsjö under his own management. Gunnar feels that the status has been raised considerably today, because there are so few remaining mould makers. Swedish mould makers are not only demanded regionally and nationally but also internationally.

## Gunnar Englund berättar:

I would like to convey how I, when I studied with Anders Karlsson, felt great respect for his knowledge. As a result, I realised that he was really a key person at the glassworks, as he had insight into the entire manufacturing process, from the designer's idea to the finished product whilst also having a solid knowledge of how it was done in

the past, in order to guide both new and sometimes even older designers in the development of new products. He was also interested in testing new technologies and mould solutions to push the development forward. Another aspect of the mould maker's work is that they are often the one who will create models in wood, so-called "Plugs" which are then scanned and converted into graphite, iron or steel moulds. A qualified work that is a blend of sculpture and fine carpentry. As far as the status is concerned, I think that it might historically be lower than the glassblowers, which probably was apparent in salaries and housing, but that this naturally levelled out during the magnitude of the Swedish glass, as the prerequisite for the development of techniques depended on the skill of craftsmen from all disciplines that could collaborate in teams.

**Thomas Jacobsson from Jacobsson's Mould Workshop in Hovmantorp says:**

"Making moulds by hand makes me think of the '60s. That was how we worked when I was an apprentice and learning to become a mould maker at Sandvik and Orrefors Glasbruk. Back then we used tools such as the bow saw, axe, circular saw and an old lathe. At that time you made moulds just as you are describing. But a lot has happened since then! In 1969 I started my own mould workshop. I was young, just 22 years old, and of course eager to keep up with the new times. Not only with tools and machines that streamlined and increased the effectiveness of production but also of the working environment. It is just as much about developing the workshop and its' working conditions, so that you worked ergonomically, could walk and stand correctly, with ventilation that



Interior picture from the section of Jacobssons Mould Workshop where wooden moulds are produced. Photo: Thomas Jacobsson.

keeps the air as clean and dust-free as possible, to avoid heavy lifting or work in such a way as to wear the body unnecessarily.

As a mould maker, one should have a good basic knowledge of the actual glass production and the glassblowing, so that you know how the shape should look for the glassblower to actually be able to get in and out of the mould. It is said to be part of the craft. The design of the glass piece can mean that odd solutions are sometimes required and it can be something of a challenge from time to time. The craft of mould manufacturing – irrespective of the working method in general – also consists of the choice of material (if you work in wood, you need to have an eye and feeling for what is good wood to work with) and the finishing work of smoothing and mounting the mould.

But the big difference now is that I mainly use computer-controlled CNC machines to produce the moulds. I do not regard CNC machines as a hyper-modern invention. I've been working in this way for more than 30 years. The difference is in the precision. With the old lathes, you cannot turn moulds that are exact on the millimetre and some of the drawings we get have dimensions with tenths of millimetres needed. Of course, we still get regular drawings on paper and also finished objects, but much of the assignments we get are with digital 3D files. The schools that train designers today teach them to work in various design and drawing programs for computers. This means that most designers under the age of 50 deliver their drawings with finished CAD CAM files.

With CNC machines, the production rate becomes higher. When the programming is done and the material (wood/graphite/ceramic material) is mounted in place in the machine, it takes care of itself and I can use that time for other things – such as smoothing and mounting. And then it is also about the size. Today we can make solid wood moulds that are as large as up to 100 cm in diameter. It is possible, but I have not tried yet. This does not mean that I never use lathes – I do so sometimes when the design of



Prepared and blocked wood blank for what will be a large form for Filippa K. Photo: Thomas Jacobsson.



One half of the pre-cut wooden mould before mounting. The inside dimensions of the mould are a total of 600 mm high and 470 mm in diameter. Photo: Thomas Jacobsson.





The exact mould “in action” in the glass workshop. A tough match for Lars Axelsson at Bergdala glass factory, who must have the help of the whole team to manage to blow the large piece. Among other things, being lifted (and later down) with a forklift during the process. Photo: Thomas Jacobsson.



The last order for the year 2017 is ready in the days before Christmas. Eleven wooden moulds ready to be packed and sent to a glass factory in Finland. Photo: Thomas Jacobsson.

the mould and the tolerances allow for that working method.

Obviously, the glass industry looks different today compared to when I started Jacobssons Mould Workshop. At that time, there were several large glassworks in the immediate surroundings and much of the time was spent on making moulds for use at Orrefors and Sandvik’s Glassworks. Many of these glassworks are completely gone today and those that remain are considerably smaller in the number of glassblowers. We produce graphite moulds for Kosta glass factory, but they have their own workshop where wooden moulds are made. We can relieve the mould master Strand at Kosta when the wooden moulds become too large to turn in the lathe or the divisions on the moulds becomes too many.

But fewer large glassworks does not mean that Swedish glass is declared dead. The modern technology has also made it possible to run small glass blowing studios. These can be said to have grown like mushrooms in the forest. They also need moulds and blocks and other tools. So, instead of having a few really large glassworks in the Kingdom of Crystal, as customers, it has expanded with many smaller customers spread across the country. We are also contacted by building conservators, architects, restaurants and the like, who need moulds for glassblowing. It was not like this in the past — then it was the factory manager of the large glassworks who ordered moulds and he knew exactly what he was talking about. Nowadays it can be laymen who do not really know anything about glassblowing, of what you can and what you cannot do. Many times they do not even really know who is going to blow the glass, so we have to act as some sort of intermediary and direct them towards the appropriate glass workshops.

For more than 20 years, we have also supplied moulds for all over the world, to glass studios in Mexico, USA, Scotland, Norway, Germany, France, Malta, to name a few. Perhaps mould makers are a dying breed elsewhere in the world as well? In

any case, we have seen a significant increase in demand in recent years. Shipping usually takes no more than 5 working days. Once wrapped and sealed, there are never any problems with the mould drying out. And should it develop grey mildew on the surface then it is just burnt away.

Life as a mould maker can be said to be varied. What makes it fun is, of course, the meeting and collaboration with creative people. And by that, I mean not only designers but also skilled glassblowers and smart, innovative studio masters. It has always been a challenge, where everyone wants to push the development forward — to find ways to shape the glass in new ways, think differently, find new solutions. And when a designer gets some new, crazy untested idea or draws an “impossible” design, then it is up to the glass masters, glassblowers and mould makers — to try and find a way to make it possible. Such challenges give life a little spice.

Next year, Jacobsson’s Mould Workshop will be 50 years old and throughout that time I have never gone to work and thought it was boring. Rath-

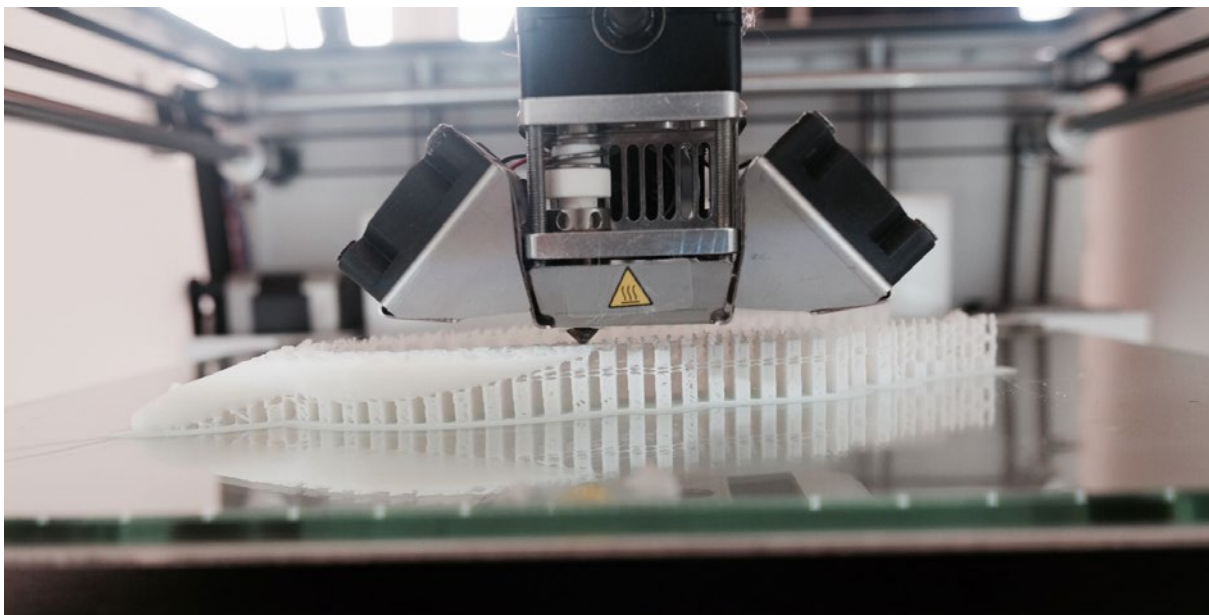
er, it is more that I have a little trouble stopping because I enjoy it. But not even I am an eternal machine. Therefore, there will be some changes within the year to come and the plan is that an apprentice will be trained to take over eventually. There is a good chance for the mould workshop to continue on for many years.”

### **The importance of the wooden mould today and in the future**

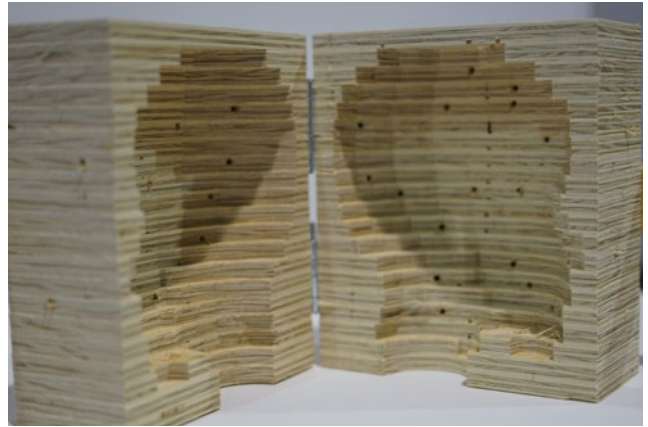
Today, work is underway to develop innovative methods in wooden mould production. Perhaps these will revolutionise glass production.

#### **Maja Heuer, The Glass Factory, says:**

In a five-day experimental workshop in September 2017, six international glass artists worked with the material of glass in combination with FabLab machines, such as CNC machinery and a 3D printer. A computer program was created for the digital 3D printer to produce moulds in various materials, which makes new ways possible within working with manual mould blowing. The workshop focused on the latest digital technologies to test and develop new methods for



A 3D printer used in the workshop. Photo: The Glass Factory.



In 2017, several workshops were initiated within the Nordic project "Handmade – Scandinavian Glass – starting all over", a collaboration project between three Scandinavian glass museums – The Glass Factory, Boda (Sweden), the Glass Museum Ebeltoft, Ebeltoft (Denmark), and the Finnish Glass Museum. Riihimäki (Finland). Photo: The Glass Factory.

producing glass. Here, digital mould production was combined with manual glass blowing. In the workshop, artists and technicians collaborated to develop an interdisciplinary approach. The possibilities for how practitioners in the future can use innovative techniques and digital printing methods were also examined.

### **The mould maker's historical significance**

The fact that the glass factories have historically had access to their own mould maker and mould workshop has probably been of immense importance for product development. Some claim that this was even one of the keys to the success of Swedish glass. At Rosdala glassworks, it was pointed out that “the procurement of iron and wood moulds as well as the recruitment of mould makers and carpenters have always been an im-

portant task for the factory management. While the iron moulds were acquired by way of outsourcing, the large supply of wooden moulds was manufactured by the factory's own mould maker — a very significant professional”.

The point with the glassworks producing the moulds onsite was so that the process of idea to prototype was short and a glass piece could be produced so that it could be viewed, and adjusted until satisfaction was reached. Keeping the idea moving forward and the designer engaged was probably also of crucial importance to success. Mould production and product development are far more cumbersome and expensive if production is further away or abroad. It is therefore easy to agree with Gunnel Holmér's description of the mould makers in the book *Orrefors – 100 år av Svensk glaskonst*, as “key people in the periphery”.









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