



## General information about porcelain

Traditional porcelain from Royal Copenhagen is high temperature fired and decorated with underglaze decoration. This combination gives the expression, which this type of porcelain is well-known for.

You can clearly feel the craftsmanship, materials and the high final firing temperature, that forms the basis of the porcelain. The objects can be a bit irregular, the colours may run a little and the glaze can vary by a sometimes visible amount of air bubbles. The craft appears as small irregularities from the original model, which is often carved hundreds of years ago. The hand-painted decoration expresses the differences among the people who made them. Every manual handling contributes to the expression.

Together, the complicated technique and craft will result in a unique object. An object we might call beautiful - precisely because it is not perfect and completely in scale dimensionally. However, both craftsmanship and technical quality standards are established for our porcelain, and every piece is judged by these standards.

Royal Copenhagen also produces, in addition to traditional porcelain, also bone china, stoneware and faience.

## Materials

### Porcelain

Raw materials typically used are Kaolin (white firing clay, about 50 %), feldspar (about 25 %) and quartz (approximately 25 %). Porcelain is fired at about 950 °C the first time and at about 1375 °C in the second firing, when the porcelain is glazed. The second firing is reducing (with shortage of oxygen) which causes the typical cool, slightly transparent look of the high-fired porcelain. The high final firing temperature means, that there are only few decoration colours to choose from, since most colours react strongly and thus disappear at high temperatures. The famous blue colour is the most used, but there are also the options of green, black and pale brownish colour.

There is a type of porcelain, which in the final firing is fired at max. 1250 °C in oxidizing atmosphere (excess of oxygen). This porcelain is yellowish and not transparent in its expression. The selection of colours for decorating is here somewhat larger due to the lower temperature of the final firing.

### Faience (earthenware)

Raw materials typically used are kaolin or clay (about 50 %), feldspar (about 25 %) and quartz (approximately 25 %). Faience is fired highest in an oxidizing atmosphere the first time at about 1160-1200 °C. The second firing, the glaze-firing, occurs approximately 100 °C lower than the primary firing and mostly with the objects hung on special racks. The inner of the faience (the body) is typically porous, and it might absorb moisture, if the glaze is not completely tight. It is also characteristic of earthenware, that it will after some time have a tendency to craze. The crazing occurs often due to reaction of the body with the absorbed water, leading to a slight expansion of the body which causes cracks in the glaze. The colour range for decoration of faience is relatively wide.

### Bone China

Raw materials typically used are bone ash (about 50 %), clay (kaolin, about 25 %) and a mixture of feldspar and quartz (called "stone", about 25 %).

Bone china is fired at highest temperature the first time, about 1250 °C. The firing is in oxidizing atmosphere, and together with the high glass content of the body (the inner of the bone china) the characteristic warm and slightly yellow appearance of the bone china is obtained. The large amount of glass in the body makes it necessary to support the articles everywhere under the first firing to keep the intended shape. The glaze-firing (second firing) takes place at about 1180 °C.

### Stoneware

Stoneware is a broad concept, which can also include low-fired porcelain products. Stoneware from Royal Copenhagen is typically made of porcelain raw materials that are added chamotte (fired clay). The latter contributes to a rustic, slightly grainy and coloured expression. The first firing takes place at approximately 1000 °C and the second firing (the glaze firing), which is reducing (with shortage of oxygen), takes place at about 1325 °C. The decoration can be made like on ordinary porcelain, typically with a somewhat coarser expression as a result.

### Glaze

The glaze materials depend on the firing temperature, but in general the glazes for traditional porcelain are consisting of kaolin, feldspar, quartz and chalk. Due to lower glaze-firing temperatures of other types of products, there may be added oxides of boron, zinc, barium,



strontium and the like. Previously there was added lead oxide containing materials because of their very fine qualities in a low-melting glaze. Today we avoid lead whenever it is possible. Older faience from Royal Copenhagen, which has a lead-containing glaze, can easily be used every day. It can be washed in the dishwasher, and it still complies with the very strict rules for lead release.

## Modelling

The model workshop is the place, where you from drawings, sculptures, etc. produce models that can be used for the production of porcelain objects.

A designer or artist submits a sample or sketch of an object, for instance a plate. Then the craftsmen create an original model, while considering the fact that a porcelain object shrinks approximately 14 % during firing. A plaster cast of the original model is used for the creation of an original mould and the original mould is then used for the preparation of production moulds.

## Shaping of porcelain

When porcelain is shaped, the methods of jiggering/rolling or casting are used depending on the type of object to be produced.

### Jiggering and Rolling

The vast majority of cups and plates are turned on rotational equipment. It can be done on machines called "roller machines". Series produced in small quantities or complicated objects are thrown or jiggered by hand. A principle used since the beginning of the production. When the porcelain mass is formed by jiggering the article is shaped on a convex plaster mould which forms the object front with flutes, reliefs, etc..

### Casting

While simple, rotational symmetrical items like plates and cups are executed by throwing, rolling or jiggering, there is a wide range of objects that only can be produced by casting. This concerns products such as tureens, teapots, coffee pots, dishes and the like. It may also apply to figurines, vases and other special objects.

The objects are formed by liquid porcelain mass (called "slip"), which is poured into a plaster mould. The plaster absorbs the water in the slip, thereby forming the so-called "body" on the plaster surface. A finished article is often composed of several different casted parts, which have been put together.

## Firing

After shaping and finishing the porcelain is dried before the firing. Traditional porcelain is fired first time at about 950°C (the biscuit firing). The second firing (the glost firing) occurs at approximately 1375°C, and the last part of this firing takes place in a reducing atmosphere (with shortage of oxygen).

Stoneware can be fired as porcelain, but it is also available in a lower fired edition, which has been fired at maximum 1280°C in an oxidizing atmosphere. Earthenware - and bone china- are fired highest the first time, approximately at 1150-1250°C. The second firing takes place at lower temperatures, 1050-1150°C, depending on the type of glaze.

Reducing fired porcelain is traditional transparent and cool blue-green in appearance, while oxidizing fired porcelain is yellowish and can be both transparent (e.g. bone china) and not translucent (e.g. earthenware).



## Decoration

We distinguish between different types of decoration such as under-glaze, in-glaze and on-glaze. The different types of decoration are applied to the porcelain surface in different ways and stages of the production. Traditional hand decoration with brush is applied on many of Royal Copenhagen's porcelain dinnerware. It can sometimes be difficult to see which decorative technique that has been used. But the type of decoration can - besides the look - be important for the usability of an object.

### Underglaze

Underglaze decoration is applied after the first firing. The decoration is covered with a glaze, and the porcelain is glaze fired. The result is a decoration which is protected by a layer of glaze. In case of traditional porcelain, the under-glaze decoration is fired at high temperature, resulting in a very limited and somewhat diffuse colour scheme. The famous blue colour withstands the high temperature best. At lower glaze firing temperature, the colour range is broader, as can be seen at Faience articles, which often are decorated in underglaze technique. Known underglaze decorated objects include Blue fluted plain, Blue Fluted Mega, Blue Flower, Christmas plates etc.

### In-glaze

In-glaze decoration is applied to the already glaze fired porcelain. The decoration is then fired almost to the level of the shiny glaze, at approximately 1,200 °C. The result is a sturdy decoration that can withstand almost the same as an underglaze decoration at the same time as the colour palette stays intact. In-glaze decorated objects are for example the Multi Coloured Elements.

### On-glaze

On-glaze decoration is applied, as appears from the name, on top of the already glaze fired glaze. The firing temperature is about 870 °C. The result is a decoration on top of the glaze layer and a wide range of colours to choose from. The decoration is vulnerable and is chosen because of the possibilities for colourful and nuanced motifs. Flora Danica dinnerware is world famous for its unique craftsmanship, and it is a good example of on-glaze decoration in its grandest form.

### Printed decoration

A decoration may be applied as a print or a transfer, either directly or indirectly as decals. An imaging technique is used as in-glaze on Star Fluted Christmas, Flora, etc.

### Other types of decoration

Finally, a decoration can be applied using coloured glazes or effect glazes, which is the case on for example stoneware. Many services have been decorated using for instance a relief in the ceramic material, together with the glaze the relief can result in a special decorative effect.

## The production of porcelain

Royal Copenhagen has for some years produced hand painted products in Thailand at our own factory. The Production have gradually been moved to our factory 80 km north of Bangkok, and the entire production with the exception of Flora Danica is running in Thailand today.

But it is important to state, that Royal Copenhagen is a Danish company with Danish products. The only thing that has changed is that the physical production and painting has moved to Thailand. Idea development, design, product development, marketing and administration are still in Denmark - and so are quality control and production of Flora Danica. Royal Copenhagen's more than 235 years old heritage and status as historic Danish, handicraft flagship is kept intact. In fact, moving the production to Thailand contributed greatly to the fact, that Royal Copenhagen is now again a sound and viable company.

So even though the products are produced in Thailand, Royal Copenhagen's products are still living up to the high quality standards that always has been practiced - and that customers expect.