# Glass: the historical perspective

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Glass ceramic: scratch-resistant, easy-to-clean and nice to look at

In electric cooktops the power is 1.5 kw

*Glass, owing to its perceived elegance, cleanliness, functionality and aesthetic properties, is considered a fundamental part of contemporary domestic appliance manufacture. Glass, indeed, has a long history of use in convivial and ceremonial life and, in spite of the aggressive development of alternative materials, definitely appears to be keeping pace. Here in part one of the series, we consider the historical perspective of the glass evolution in terms of white goods.*

The domestic appliance industry generates an incredible amount of wealth and business, and glass is one of the fundamental materials for almost all of the core white goods products. To appreciate the extent of this business, in the first six months of 2001, over 19 million white goods were shipped in the United States alone. This is an incredible feat when you think that the global white goods market is slowing down and in certain countries is already in recession.

As a reminder, the core products of the white goods - or domestic appliances market - are essentially ovens, cookers, cooker hoods, cooktops, freezers, refrigerators, washers, dryers and dishwashers. These nine lines are often collectively referred to as T9 (Top 9) products.

## T9 PRODUCTS

- ✓ ovens
- ✓ cookers
- ✓ cooker hoods
- ✓ cooktops
- ✓ freezers
- ✓ refrigerators
- ✓ washers
- ✓ dryers
- ✓ dishwashers

But where does glass come into these products and why? Moreover, what is the history behind the use of glass in domestic appliances, and why is the consumer so passionate about its use?

In a nutshell, for today's consumers, glass basically offers a sense of elegance, cleanliness, functionality and visibility. In other words, the consumer wants to feel assured and proud of the product, and glass is an ideal material to satisfy these needs - be they declared or latent. But what are the roots of this compulsion and passion? And what are the historical milestones that have made glass the wonderful material that every designer, engineer and architect loves to use?

Over the centuries, a recurring theme in glass performance improvement, and especially expansion into markets such as that of the appliance industry, has been the synergy of technologies and knowledge. Thus, the glass we know today is the product of three factors:

- correct raw materials formulation;

## THE THREE FACTORS FOR QUALITY GLASS

- ✓ *correct raw materials formulation;*
- ✓ *best manufacturing techniques;*
- ✓ *application-consumer relationship knowledge.*

- best manufacturing techniques;
- application-consumer relationship knowledge.

As will be seen, the glass industry has only been able to make significant progress when at least one breakthrough has been achieved or has occurred in one of these three areas. Moreover, the evolution of home surroundings and concepts of good, harmonious living such as welfare, feng shui, green-living and vegetarianism etc. are all reflected in everyday objects including appliances.

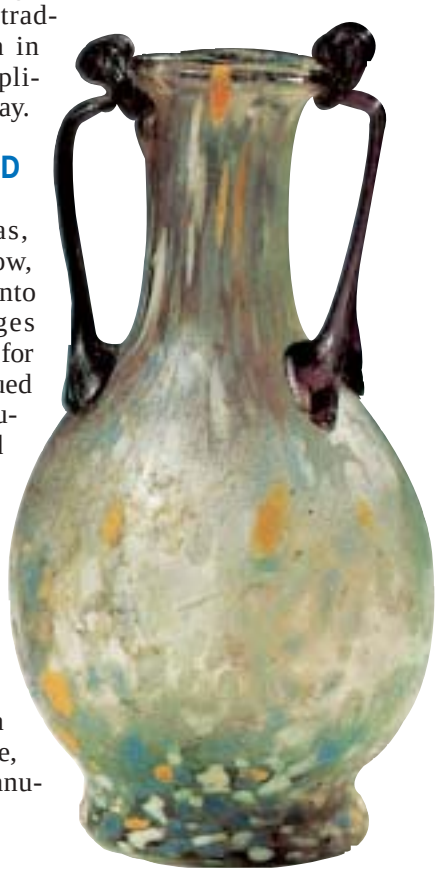
Going back in time reveals that, for convivial and ceremonial events, both glass pottery - goblets, bowls, vessels, and so on - and jewellery and perfume bottles, and the like, played a central role. Clearly, this link between glass, food, drink and enjoyment is still a key part of our everyday life, and home appliance design reflects this commonality.

## THE ROMANS

Another equally important factor is the sense of modernism, 'living' architecture and religion associated with glass: there is a direct, historical link between glass, nature, festiveness and the home in general. For example, it was the Romans who were first to see the potential for the use of glass in the home. The discovery, made around 100 AD in Alexandria, that adding manganese dioxide to glass would mask its inherent green tinge and give a clear cast glass, was quickly put to use in the most important villas and lodgings in Rome. Furthermore, during the period of the Roman empire better furnace design not only provided higher temperatures and better combustion control but also the complete melting of constituent materials: a fundamental requisite for quality.

Another essential part of glass development was the vicinity of labour and deposits of sand. In fact, the Romans imported soda from Egypt and Syria and set up glassworks, such as in the Italian Campania region, to transform glass from a luxury product into an everyday item. The Romans also set up numerous other glassworks across Europe and further afield, including Sidon, Tyre, East Roman Byzantium, Aquileia, Amiens and Cologne, and even traded in China.

Clearly, this proliferation not only has its roots in the access to sources of basic glass ingredients and labour, but also depended on expertise in design, manufacturing and trading: very much in line with the appliance industry today.

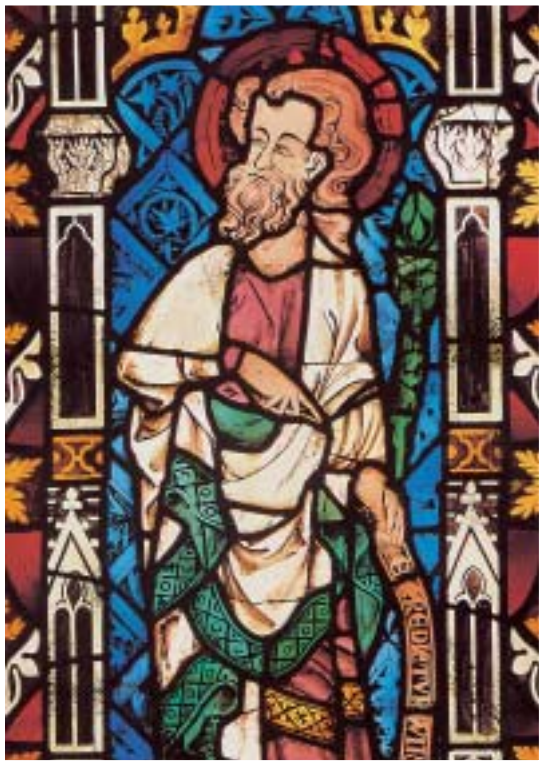


Group of coloured amphorae, Italy, eastern Mediterranean, first century AD

## THE DARK AND MIDDLE AGES

Progress was, nevertheless, slow, and even well into the Middle Ages glazed windows, for example, continued to be a great luxury, hindered especially by difficult heavy manual fabrication methodologies, i.e. windows were blown with a glassblowing pipe, cut open and manu-

Venetian drinking tazza, second quarter 16th Century



Detail of stained-glass window, 14th Century

ally rolled flat. This narrowed product advancement, consequently window dimensions were very small and the only possibility of making a large window was to join them together with lead strips.

It was during this period that Britain saw its first use of stained glass, in 674 AD, while the Romans were already producing luxury glassware for exportation in Alexandria in 1000 AD. After a period when there are no real records of glassmaking, in the 12th Century there was renewed interest, with the finest stained glass windows being produced during the 13th and 14th Centuries. Curiously, around 1250, glass was also developed for eyeglasses that subsequently led, albeit a few centuries later to microscopes and telescopes, i.e. for more scientific and non-convivial needs.

The Venetians were to dominate glass production from the 15th Century through to the 1700s, with their development of colourless, highly transparent glass known as 'cristallo', used to produce a wide range of items. However, the works of the Murano craftsmen remained for the wealthy, meaning that the focus was essentially still on tableware and ceremonial objects.

## THE PRE-MODERN ERA

Thus it was that flat glass production techniques, for example, remained more or less the same up until the mid-19th Century i.e. molten glass was poured onto a metal plate and flattened with a roller. The glass then had to be polished to remove the blemishes from the surface, making it particularly laborious and expensive.

During this time the famous Lorraine technique - known as 'muff blowing' - was developed and produced lighter sheets of glass, as used in London's Crystal Palace, built in 1851.

In the late 1830s, James Hartley was granted a patent for a new process of casting glass. This rolled plate glass was incredibly strong, translucent and affordable - ideal for the large skylights and luminous roofs needed by factories and the natural lighting of domestic environments. James Chance improved this method by passing the glass through two rollers, producing a material that was reasonably smooth, clear and bright on both sides.

By now the industrial revolution was in full swing and, as time progressed, a growing awareness of the need for cheap, affordable, diversified glass developed. This need for cost effectiveness coincided with growing international competition, better transport, an industrialist approach to product development and a new, broader, economic framework. The desire to provide glass for the masses inevitably also brought about fierce competition throughout Europe - Germany, Belgium, France, England, and so on - pushing the glass industry to

## GLASS HIGHLIGHTS: 1800 TO 1950

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|---|---|
| **Late 1830s** | *Pantent granted for casting (rolled plate) glass;* |
| **Mid 19th Century** | *Lorraine technique (muff blowing) developed;* |
| **Late 1800s** | *automation: e.g. US bottle-making plants;* |
| **Late 1800s** | *researching and patenting of glass properties and processes;* |
| **Late 1800s** | *research, development and production of optical glass;* |
| **Early 1900s** | *development of blown and pressed domestic glass* |
| **Early 1910s** | *development of Pyrex* |
| **Late 1920s** | *mass production of Pyrex* |
| **Early 1930s** | *Tempered glass* |
| **1934** | *Solex glass developed* |
| **Early 1940s to early 1950s** | *Solex used in architecture;* |
| **Early 1940s to early 1950s** | *GM cars start producing curved windscreens;* |
| **Mid 1940s** | *Pyrex heat and corrosion-resistant cookware;* |

parts of Europe, such as Mainz in Germany and the North East of England, where there were natural resources such as coal, and cheap labour in abundance.

The concept of automation and plant innovation was also starting to develop, for example, the automatic bottle making plant in the United States in the late 1800s. Incredibly, up until the mid-17th century, bottles had essentially been made from metal, wood or leather.

At the same time, the concept of researching and patenting glass properties and processes was taking place. The forerunner of this quantum leap is rightly attributed to Otto Schott (1851-1935), a chemist and technologist, who successfully - albeit after many unsuccessful attempts - investigated the dependency of physical properties of glass on its composition by using a scientific and systematic approach. It is often said that Otto Schott rediscovered glass and laid the foundation stone of modern glass technology that we all take for granted today.

He later teamed up with Ernst Abbe (1840-1905) to research, develop and produce optical glass. This work led to the development of the first reliable glass thermometer that hardly expanded when heated, was therefore precise, and had all the right optical and mechanical properties typical of today's products. For this reason, one also considers this work as being the test bed for much of today's high-tech appliance glass.

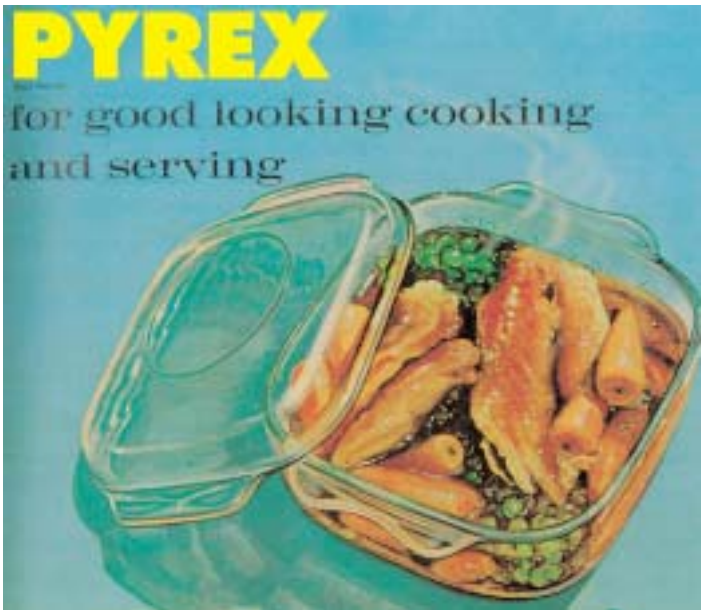
The first half of the last century provided significant innovations in the development of domestic - blown and pressed - glass including glass lamp bulbs (early 1900s), Pyrex (early 1910s) and tempered glass (early 1930s). But glass manufacturing was still a slow process - sheet glass especially - when compared to those found in other industries such as car manufacturing.

### THE MODERN ERA

Things changed dramatically in the early 1950s when Sir Alistair Pilkington invented the continuous flat glass process that involves drawing glass directly out of the furnace then floating it on a bath of molten tin. Thanks to his ingenious work it has been possible to mass-produce good quality flat glass found

Silver streak iron 1942-1946

in modern appliances including cooktops, cooker hoods and oven doors, not to mention modern architecture. This combination of modern design and architecture is one reason why consumers perceive appliances with glass as being avant-garde, high-tech and appealing. From the early 1940s to early 1950s Solex glass, first developed in 1934, was produced in the United States in large quantities for architectural use, GM cars started producing curved windscreens, architect Philip Johnson completed the first glass-walled box home (United States) and the famous 'Silver Streak' glass iron was launched (United States).




Pyrex advertisement 1963

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## GLASS HIGHLIGHTS: 1950 TO PRESENT DAY

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|---|---|
| Early 1950s | *Pilkington invents continuous flat glass process* |
| Mid 1980s | *Tempered and bent glass for gas and electric cooktops* |
| Mid 1980s | *Quartz and halogen lamp grilling elements* |
| Late 1980s-90s | *Ground and thermoformed glass electric cooktops* |
| Late 1980s | *Opaque glass for electric induction cooktops* |
| Late 1980s | *Reflective glass for oven doors* |
| Late 1990s | *Non-stick coated enamels for oven cavities* |

Since the end of the Second World War there has been a continuous harvest of specialist glass and derivatives, especially in the kitchen environment. Technical borosilicate glass such as Pyrex, mass-produced from the late 1920s onwards, brought about heat and corrosion resistant cookware. This provided the first cooking concepts of 'look right through' and 'oven to table'. It also brought about Pyrosil and opaque Pyrex tableware. Similar approaches also reached the washing machine with the round, pressed glass door.

This was followed by pyrolitic oven temperature-resistant vitreous enamel (450°C), glass fibres for insulation and materials strengthening, UV filtered halogen lamp bulb and protective glass, now common in all cooker hood and oven lighting systems.

We also now have quartz and halogen lamp grilling elements in microwave ovens, tempered and bent glass for gas cooktops (mid 1980s) and ceramic - both ground and thermoformed - glass electric cooktops (late 1980-90s), opaque glass for electric induction cooktops, reflective glass for oven doors (late 1980s) and non-stick coated enamels for oven cavities (late 1990s). In the last two decades, consumer awareness of technology and aesthetics has changed dramatically. A very good example is the electrification of appliances with interactive retro-illuminated glass vacuum displays combined with designer kitchens/appliances, having internet connectivity and touch controls. Furthermore, glass is being joined by other non-glass materials, as well as by other technologies such as laser cut steel frames in electronic gas cooktops.

Glass ceramic cooktop panels use today's normal household electricity supply

But, undoubtedly the spotlight of the T9 appliances mentioned earlier falls on cooking products. They have taken on the most innovative and dominant role in using glass technology and, for this reason, cooking appliances should be considered not just the most challenging but, also, trend setters of their genre. As a demonstration of this, and on a closing note, arguably the greatest innovation in recent appliances - and cooktop - history, has been the birth of the glass ceramic for cooktop panels.

Electric glass ceramic cooktops have proved very successful but lack the usability and low price of today's gas cooktops. Therefore, the fundamental consumer trend here is the latent desire for design, cleanability and functionality. But, so far, the combination of electric and gas technologies has failed to deliver a true consumer 'gas-under-glass' cooktop concept. This is perhaps emblematic of the challenges facing appliance manufacturers and glass suppliers. Glass, though, is known to be remarkable material, so let us wait and see what the future will bring.

***WHIRLPOOL - UK**