Investment Casting or The Lost Wax Process

Apecs Investment Castings was founded in 1963 and is now situated in the Melbourne suburb of Burwood where we have been since we outgrew our Canterbury factory in August 1987.

The company name (APECS), stands for Anthony Philip Eccles Casting Service. Investment is a type of plaster that we use in our process of reproducing multiple copies of an original master pattern which is usually supplied to us by our customers.

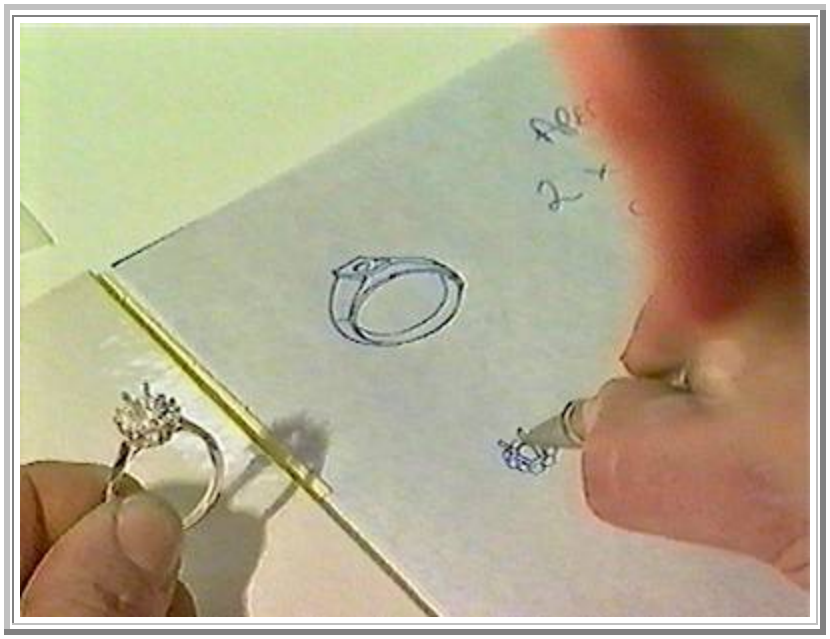
This is a classic 18ct yellow gold emerald and diamond ring taken from the Apecs catalogue.

The next series of photos will show the steps involved in producing multiple copies of this ring.

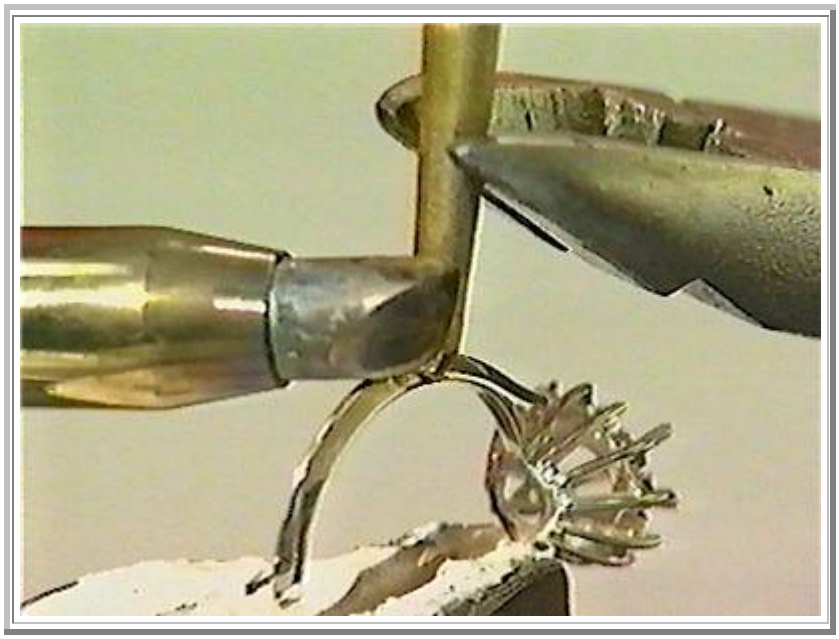
An original master pattern is designed and fabricated by our customers and supplied to us to reproduce in the quantities and metals of their choice.

It is important to ensure that the master is made as accurately as possible and to pay particular attention to the finish of the master pattern. The better the quality of the master pattern the better the casting result.

The finished master pattern ready for the caster.

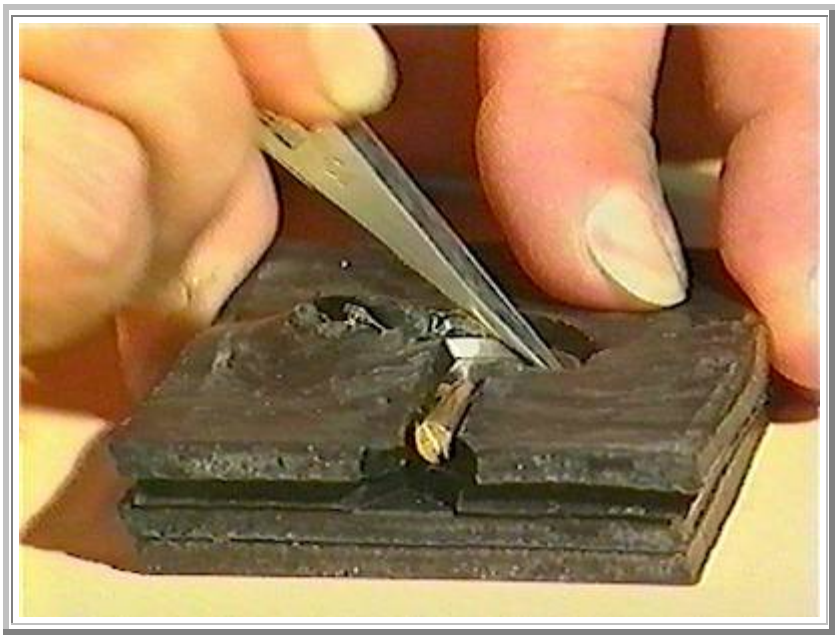


A picture of the master pattern is drawn and a mould number is allocated for identification. When the customer wants to reorder he quotes the mould number for the pattern he wants.



A sprue is soldered onto the pattern. This sprue enables the pattern to be easily located in the mould and will provide the path for the wax to be injected into the rubber mould.

To make a mould the master pattern is placed between sheets of uncured vulcanising rubber.

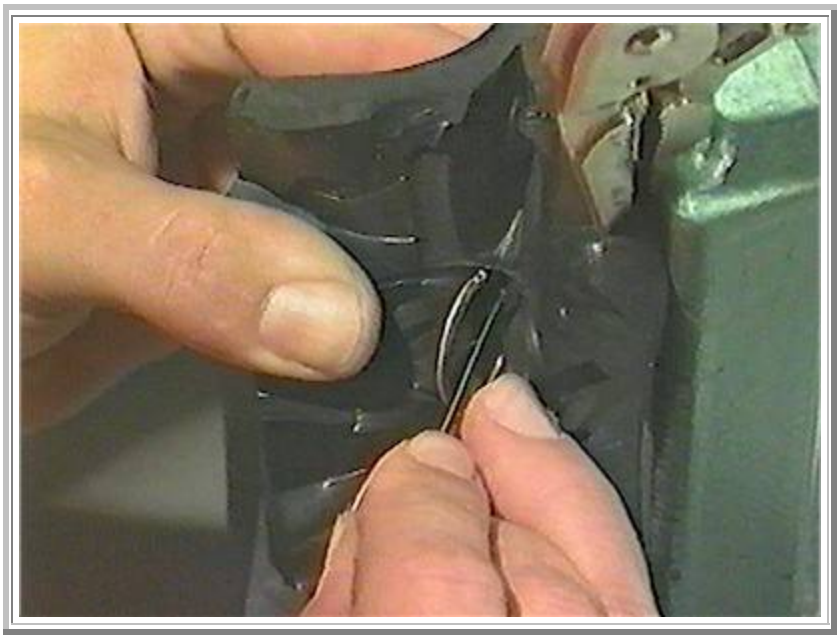


Rubber is cut and carefully packed in and around the master pattern.

The prepared mould is placed into a preheated steel moulding box or die. This die provides the shape that the finished mould will be.

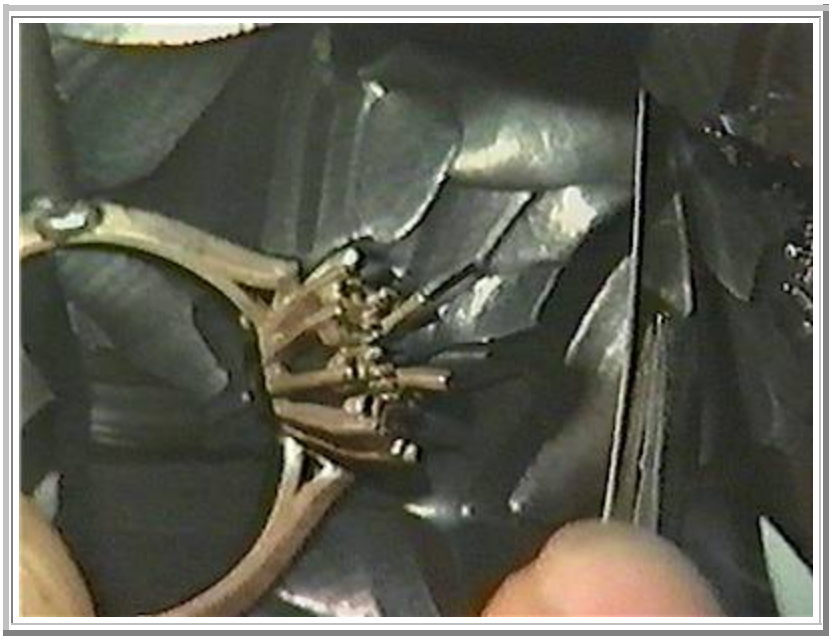
The mould is placed in the vulcaniser and heat and pressure is applied to form the mould and cure the rubber. Depending on the thickness of the mould being made and the type of rubber being used, the mould is heated for 20-60 minutes at a temperature of 145°-155°C.

After vulcanising we have a solid block of rubber with the master pattern encased inside. The mould is clamped and cut open using a scalpel.



The mould is cut open by carefully following the sprue to reveal the master pattern.

Many people can cut open a mould, but it takes a skilled mould maker to cut out a mould properly. The more complex the master pattern, the more skill is required to cut the rubber in the correct position so that waxes can be released without breaking or distorting.



The top of the setting has now been released.

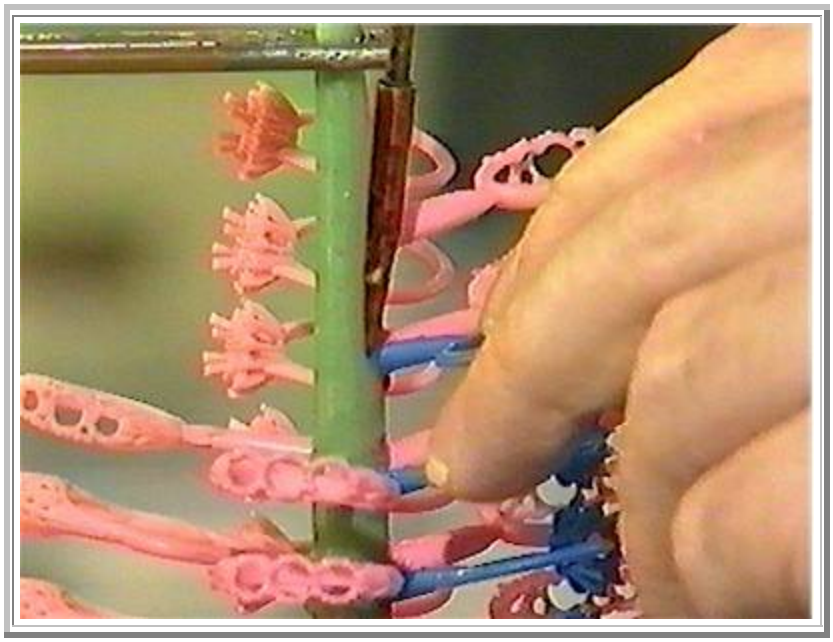
The mould is now cut in two and the other half of the setting will then be released. The mould has been cut in a zig zag fashion and the edges of the pattern followed where possible. This ensures that the mould locates back together properly and the part lines are kept to a minimum. The mould is then carefully "cut in" along edges and claws to allow the mould to fill easily and the wax patterns to release without distortion.

The machines shown here clamp the mould halves together, apply a vacuum to draw the air from the mould cavity and then inject wax into the mould. Timing and pressures can be adjusted to suit the wide variety of patterns that we cast.

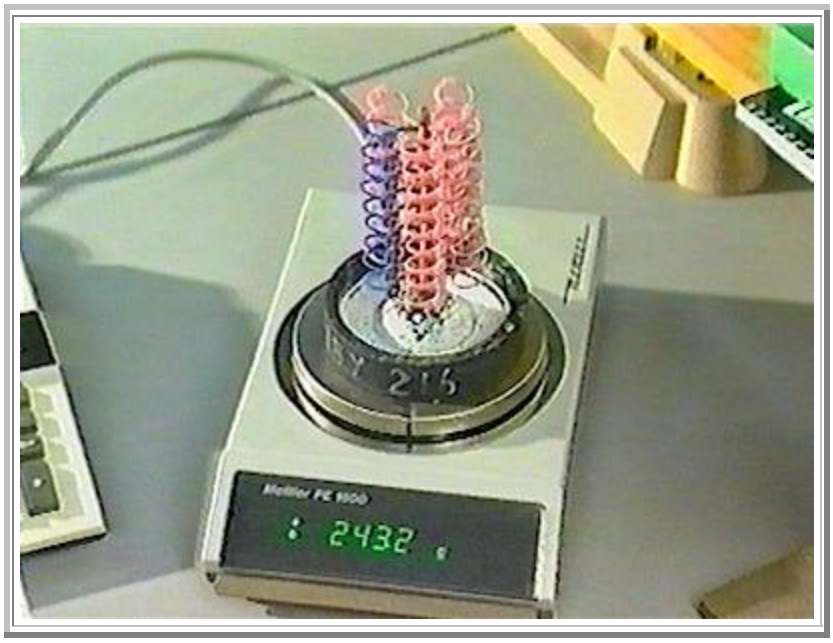
The injected wax is allowed to cool for several minutes before the mould is opened and the wax is removed from the mould.

After the wax pattern is removed from the mould it is inspected and compared with the master pattern to ensure a true reproduction.

When the required quantity of wax patterns have been run they are then set up for casting.



Using a soldering iron, the waxes are welded to a main stem to form a wax tree which could contain more than one hundred individual waxes.



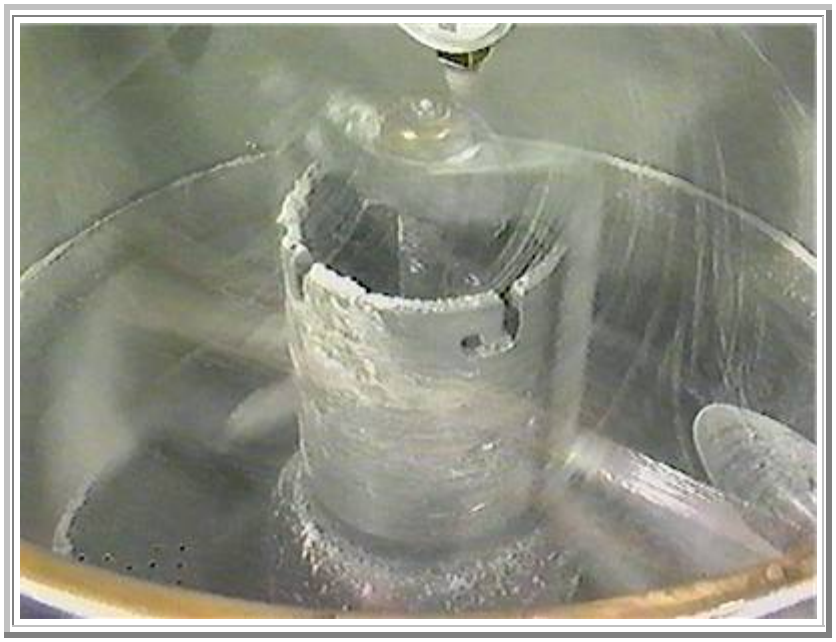
The tree is weighed so that the amount of metal required to cast the tree can be calculated.

The weight of the rubber base is deducted from the total tree weight to give the weight of the wax tree. The wax weight is then multiplied by the specific gravity of the metal to be cast to give the weight of the metal required to cast the tree.

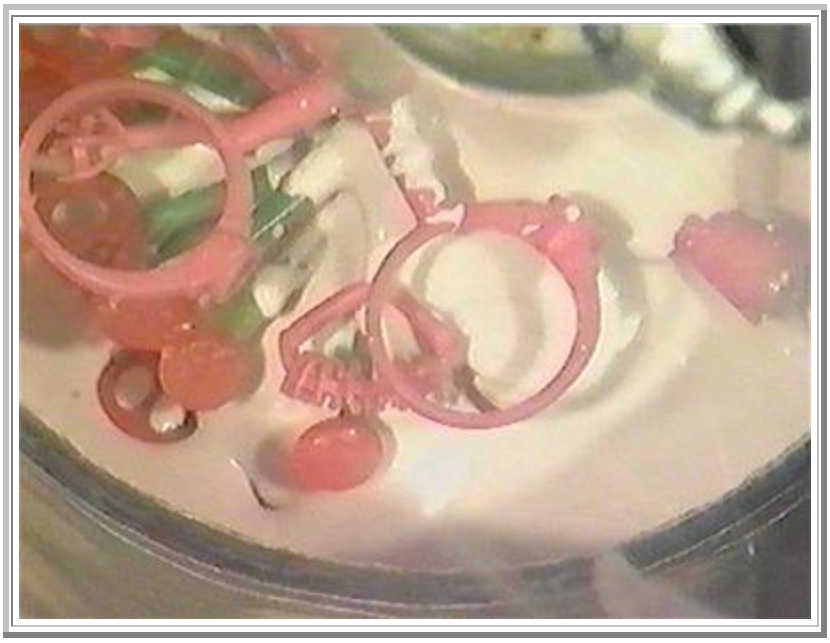
A perforated stainless steel flask is then place around the tree. The perforations allow the vacuum to have full effect on the tree when the metal is being cast into it.

The flasks to be invested are placed in the bottom chamber of this investing machine. A measured amount of water is placed in the main mixing chamber and the investment powder is then placed in a sieve above the water.

The lid is closed so that vacuum can be applied to the chamber.

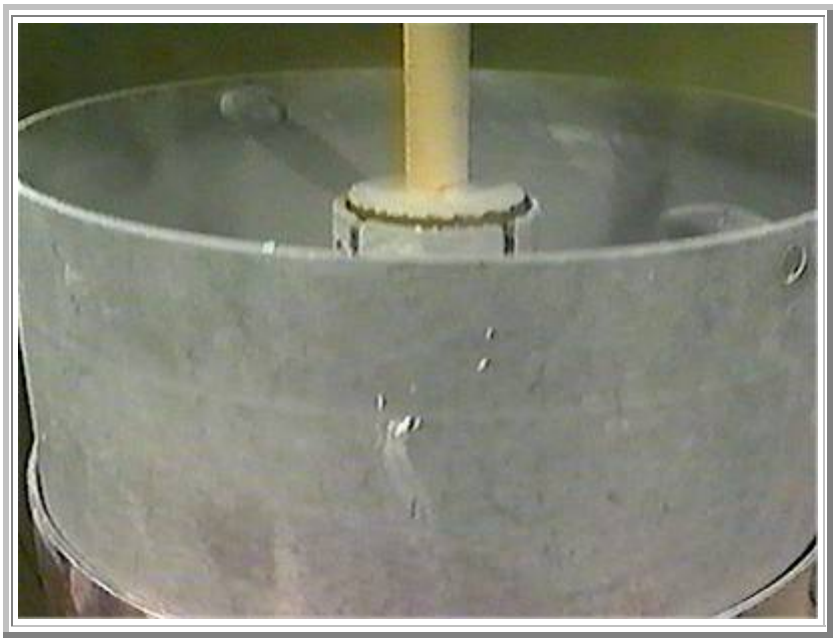


Once the lid has closed a vacuum is applied and the mixing is commenced. The investment is sieved into the water where it is mixed for approximately seven and a half minutes.



The valves above the flasks are opened to allow the investment to flow into the flask and cover the waxes.

The last waxes are covered with investment. Because the investment is mixed and poured under vacuum, the investment fills the smallest cavity and creates a perfect mould of the wax tree.



Once the flasks have been filled, the vacuum is released, the lid is opened and the sieve is removed so the machine can be cleaned.

The mixing chamber is then swung to the right hand side over the washing out sink and the flasks are removed from the bottom chamber.

The flasks are put aside on a table to set and allowed to cure for at least one hour.

The flasks are soaked in water for about twenty minutes to assist in the removal of the wax and then placed in a melt out furnace at 180°C for one to two hours.

The flasks are then transferred to a burn out furnace which heats the flasks gradually overnight to 700°C. This removes all traces of carbon residue left by the wax and cures the investment ready for casting. Once cooled the old tree wax is collected and discarded.

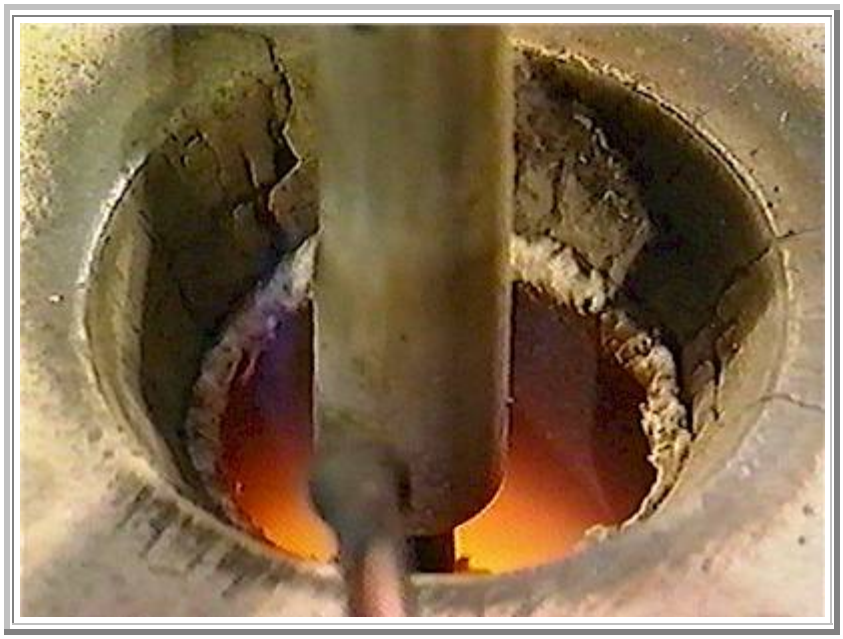
Apecs alloys their own casting alloys, therefore we also need to be able to assay the alloys in order to guarantee their quality. A half gram sample of each alloy made is weighed to four decimal places and placed in a cube of lead foil for the fire assay.

Small porous, bone ash cups called cupels, are placed in a furnace and heated to 1100°C ready for the test sample.

The test sample, wrapped in the lead foil, is placed in the cupel for twenty minutes. The lead draws the base metals in the alloy into the cupel and a silver and gold alloy remains in the cupel. This sample is then rolled very thin, annealed, weighed and placed into nitric acid. The acid dissolves the silver and leaves only a gold sample behind. The gold is washed, dried and weighed to give a very accurate percentage of gold in the test alloy.

Once the assay result confirms that the carat rating is correct the alloy is weighed out ready for casting.

The weighed out alloy is put into the crucible of our vacuum casting machine.



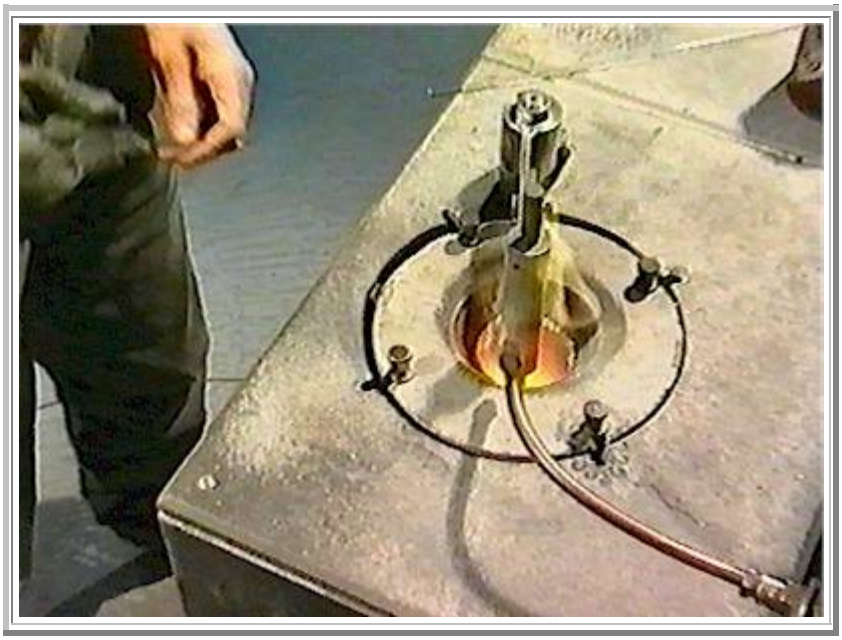
Induction heating is used to melt the alloy in the graphite crucible.

After the metal has maintained the desired temperature for a period of time, the flask to be cast is retrieved from the burn out furnace. The flask temperature is usually at 600°C.

The flask is placed in the casting chamber.

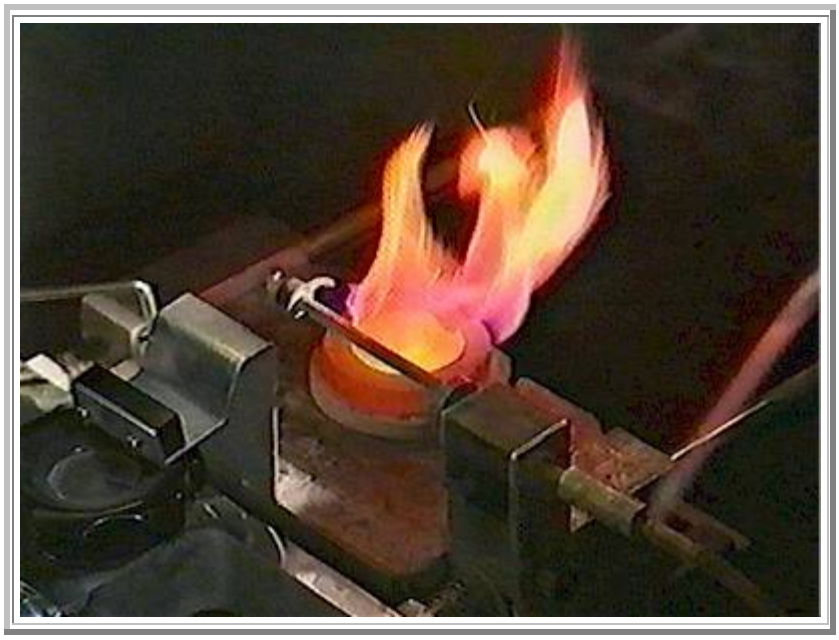
The flask needs to be seated squarely in it's cradle. The rubber o-ring on the bench top will be placed on top of the flask as a seal for the vacuum.

A pneumatic cylinder lowers the flask in the casting chamber so that the chamber can be swung into position under the crucible. Once in position the flask is forced upward to seal the flask and the casting chamber against the crucible support table.



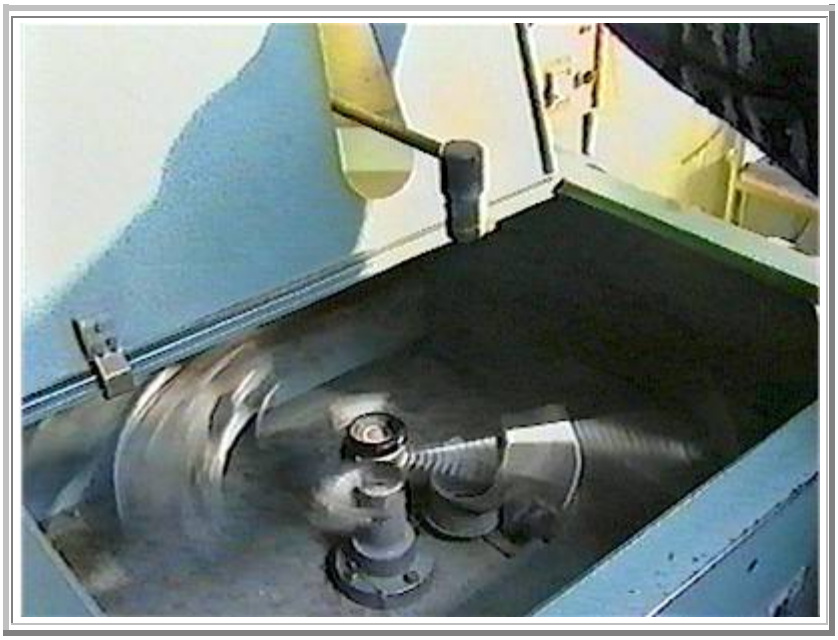
Vacuum is applied to the casting chamber and when it is established the rod seen in the middle of the crucible is raised, allowing the metal to be drawn through the hole in the bottom of the crucible and into the flask below.

The cast flask is then removed from the chamber and set aside to cool.



Some metals are more suited to be cast centrifugally rather than the static vacuum cast.
Here a 9ct pink alloy is being melted for casting.

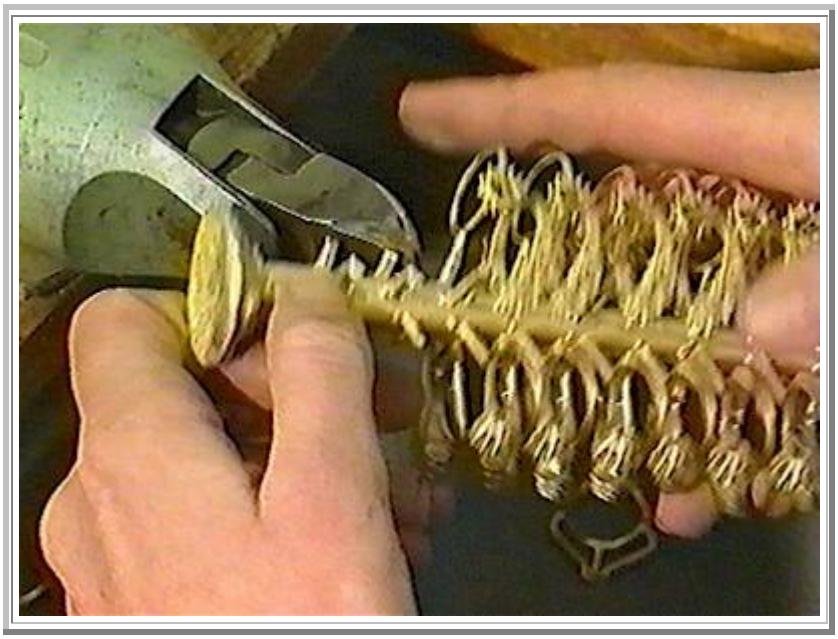
When the metal has reached the required temperature, the induction melting coil is lowered from around the crucible and the cradle holding the crucible is slid towards the waiting horizontal flask.



The centrifugal force forces the metal up the wall of the crucible and into the flask.

The flasks are allowed to cool for about twenty minutes and then quenched and washed out. Here you can see for the first time the multiple copies of the original, cast in 18ct yellow gold.

The tree is then put into a type of sand blaster which uses fine glass beads, water and compressed air to clean all the investment from the castings. The castings are put in sulphuric acid and then reblasted to give them a clean bright surface.



The trees are dried and the castings are cut from the tree using pneumatic cutters. The castings are then sorted, checked for faults and sent to the customer for polishing and setting.

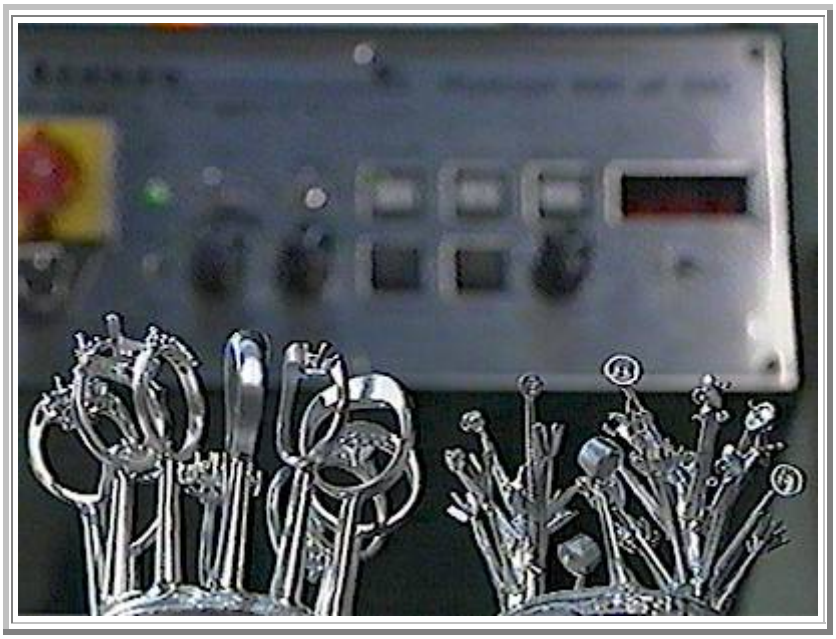
Larger pieces are moulded using silicon rubber. This is a cold setting rubber, so patterns that could not withstand the heat and pressure of vulcanising can be moulded in this rubber.

Most of these silicon moulds are hand poured using a fluid wax which gives excellent detail.

Vents need to be cut into these moulds to allow the air to escape as the wax fills the mould.

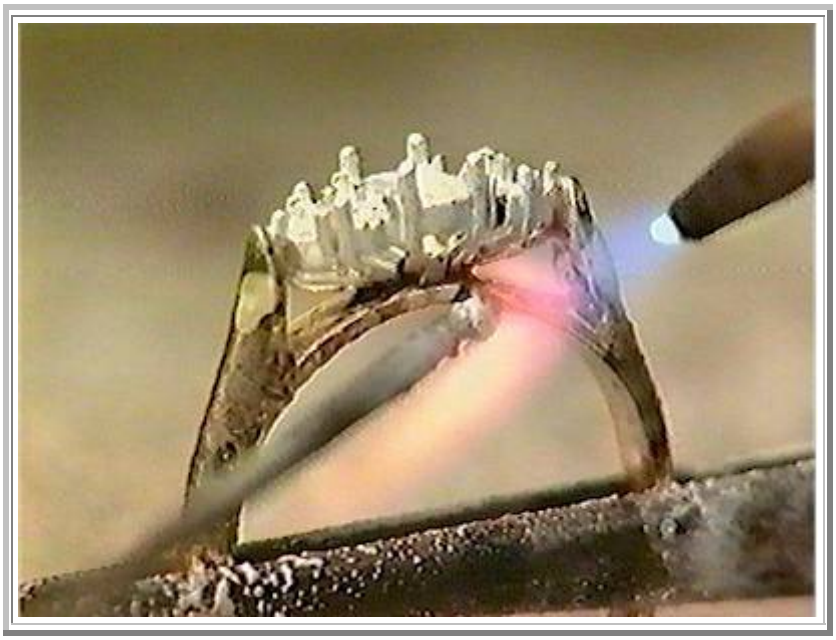
Apecs also casts some of the more difficult metals such as platinum.

Platinum melts at 1772°C, so specialised equipment needs to be used to melt and cast platinum efficiently. This is a "Linn Platicast 600" centrifugal casting machine, capable of melting up to 600 grams of platinum.



Platinum needs a high torque, high acceleration casting machine to transfer the metal quickly from the crucible to the flask before it chills. The trees are set up usually with the rings sprued directly to the button so that the metal travel distance is as short as possible.

Apecs released the first form of this alloy in 1995. Sales and satisfied customers have increased steadily as those that try it enjoy the benefits of a firescale free alloy.



As the awareness of safety in the workplace increases so does the need for safe cadmium free solders.

Apecs provides a range of solders in sheet form.

A good range of solders is available in various grades including platinum and pink gold solders.

One of the larger pieces that we've cast, this eagle was cast in three pieces and assembled.

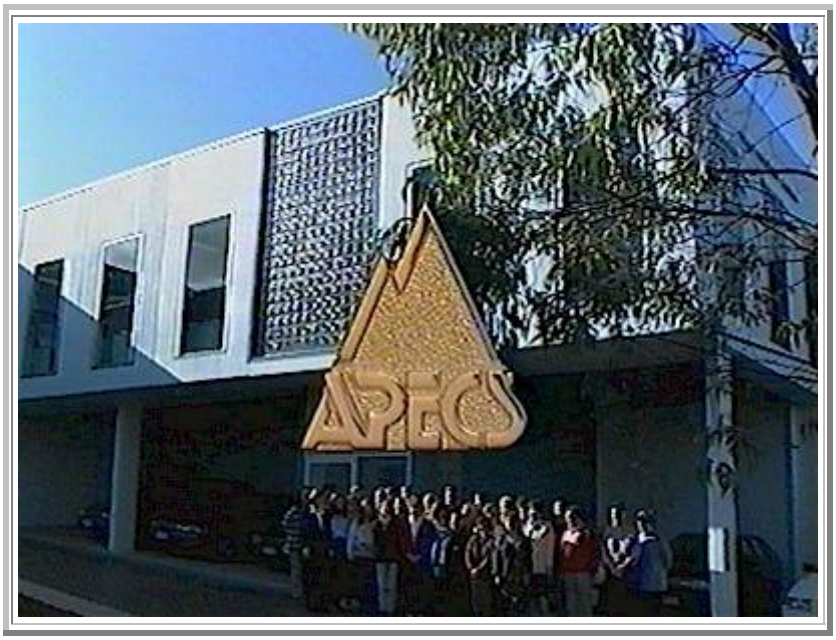
This chess set cast in sterling silver is a limited series featuring Australian native animals.

Sterling silver chess set.

Chess pieces.

Limited edition, the pioneer series also cast in sterling silver.

This MG was cast from a plastic model in sterling silver.



Proud to be Australian.

Anthony Philip Eccles Casting Service