

## HOW MINTED GOLD BARS ARE MANUFACTURED

### BACKGROUND INFORMATION

**Minted gold bars** are normally manufactured from cast gold bars that have been rolled to a uniform thickness.

In broad summary, the rolled cast bars are punched with a die to create blanks with the required weight and dimensions. To record the obverse and reverse designs, the blanks are struck in a minting press.

This supplement describes in outline a typical manufacturing method. It can be noted that most manufacturers apply their own variations, and many now automate parts of the production process.

### FROM CAST BARS TO BLANKS

The manufacture of minted bars follows a number of clearly defined steps. The first is to produce long, flat cast bars from which blanks can be made. These bars can be obtained in two ways, either from cast iron moulds in a pack or from a continuous casting machine.

#### Traditional: Cast iron moulds in a pack

The cast iron block is recessed to provide a mould which gives the required width, thickness and length of the cast bar stock.

A number of moulds are clamped together vertically so that the flat base of one mould forms the side of the neighbouring mould. The melted gold is then poured into the open end of each mould in turn. When the gold has solidified, the moulds are unclamped and the bars removed.

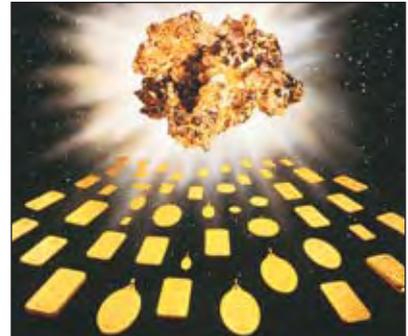
#### Modern: Continuous casting machine

The more modern method is to produce bar stock of the required width and thickness on a continuous basis using a continuous casting machine.

This machine consists of a graphite block (the die), through which an orifice is machined to the width and thickness of the required bar stock. This orifice is attached to the aperture of a graphite crucible in which the gold at a specified purity is melted, normally by induction heating or resistance heating. The die is also clamped between two cooling blocks through which water is passed.

A starter bar, machined to fit the channel in the die, is inserted into the orifice as far as the crucible, while the other end is clamped into the withdrawal mechanism. When the melted gold has reached the required casting temperature, the process is started by pulling the starter bar out of the die in a series of short pulling movements.

As the bar is drawn through the die, the gold gradually solidifies, emerging as a cast bar which is then cut to the required length (excluding the starter which is removed). Gold in the form of granules or cut pieces of large bars is added to the crucible at intervals to maintain continuous production.



Minted gold bars are manufactured in a variety of shapes for the international market.

PAMP  
Switzerland



A continuous casting machine producing flat cast bars.

Rand Refinery  
South Africa



Rolling flat cast bars to the required thickness.

The Perth Mint  
Australia



## Breakdown rolling mill

The cast bars are then passed through the rolling mill to reduce them to strips of the required thickness. After a number of passes through the mill's steel rolls, the material work-hardens making it necessary to anneal, or soften, the strip. Interstage annealing is carried out mainly to recrystallise the elongated grain structure to improve the surface finish. This is done by placing the strip in a furnace.

## Strip annealing furnace

The temperature at which the furnace is set depends upon the width and thickness of the strip. Once removed from the furnace, the strip is quickly cooled by quenching in water. This process refines the grain of the material by reducing the size of the crystals and, in this way, prevents cracking during further reductions in the mill. The strip is processed through the rolling mill, as required, until it approaches the specified thickness.

## Gauging mill

Next, the strip is processed in a gauging mill – a precision machine similar in action to the breakdown rolling mill – to correct its thickness and weight. Because of the high value of gold, considerable attention is paid to limiting the amount of overweight as 'give away' on each blank. To this end, trial blanks are cut from the strip using a manual press. If it is overweight, the strip is processed through the gauging mill again until it produces a trial blank within the required weight range.

## Blanking press

The strip is then fed into the blanking press where it is passed under the blanking tool which punches out the blanks from the strip. Depending on the cutting load on the press and the width of the strip, punches can be arranged to cut more than one blank at each stroke of the press. The blanks are collected and the surplus material (known as sisal or webbing) is returned for remelting or re-refining.

## Annealing

In order to soften the blanks so that they are ready for striking, the blanks are placed in a furnace once again.

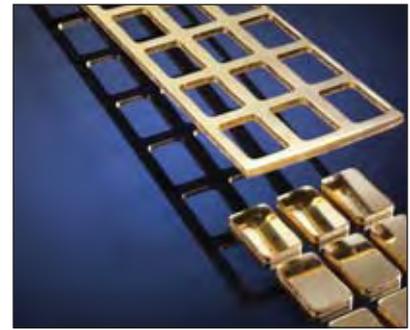
## Weighing

The blanks are then weighed to ensure they meet requirements. Those found to be under or excessively overweight are scrapped for remelting or re-refining.

If a blank is only marginally overweight, it can be brought into the specified weight range by finishing (rubbing) the surface with an abrasive material to remove the extra gold. The blank is then washed in nitric acid to remove any surface contaminants, including metallic silver. The surplus weight can also be removed chemically, for example through the use of *aqua regia* (75% hydrochloric acid/25% nitric acid). In both cases, most of the gold removed is recovered.

## Surface polishing

At this stage, the surfaces of the blanks are also burnished to produce a bright surface. This involves washing them in water and detergent, followed by rinsing, blow drying and, finally, passing them under a hot air dryer.



Blanks are cut from cast bars that have been rolled.

Heraeus  
Germany



Weighing the blanks.

The Perth Mint  
Australia



Striking the blanks between dies in a minting press.

The Perth Mint  
Australia



## FROM BLANKS TO MINTED BARS

### Striking the blanks

The minting process involves a minting press, two minting dies (for the obverse and reverse sides) and a collar which is used to control the overall dimensions of the minted bar.

As the bottom die normally sits inside the collar, the blank is placed by hand (or in an automated process) inside the collar on top of the die.

The top die is then brought down onto the blank with a great deal of force. Sometimes more than one strike may be necessary to transfer the designs on the dies to the blank.

Once struck, the newly-made minted bars are inspected prior to being packaged.

### Manufacture of dies

A modern method, now widely used to manufacture a die, involves transferring a computer-generated design directly onto a computer-controlled engraving machine.

More traditional methods include the following:

- Etching the design onto a photopolymer plate which is then reduced on a pantograph machine to form a die of the required size.
- Cutting or carving the design on the die by hand.
- Etching the design on a steel plate with chemicals.
- Creating a die from a design sculpted in relief using plaster of Paris.

#### *Design sculpted in relief using plaster of Paris*

The most elaborate method starts with a large three-dimensional model of the chosen design, sculpted in relief using plaster of Paris. From the model, a rubber mould is made. An epoxy resin model in relief is then cast from the rubber mould.

A reducing machine transfers the design on the epoxy resin model to a steel billet at the required size of the bar to form the master die.

The soft master die, after being hardened in a heating furnace, is 'hobbed' (pressed) into a softened steel billet, using a hydraulic press, to create a reduction punch.

The reduction punch is then hobbed into a softened steel billet to produce a 'working punch'.

Finally, the working punch is hobbed into one or more steel billets to produce the required number of 'working dies' which are used to mint bars from the prepared blanks.

For a standard quality finish, a single working die may produce up to 15,000 bars, the die normally re-polished after the production of around 5,000 bars.

Source: Based on information kindly provided by **The Perth Mint (Australia)**.



Many dies are now designed and manufactured using computer controlled machines.

The Perth Mint  
Australia



Argor-Heraeus (Switzerland) is acknowledged as the first accredited refiner to have manufactured minted bars, in 1952.



Most minted bars have a motif or design on their reverse side.

PAMP  
Switzerland



**EXAMPLES OF MINTED GOLD BARS**

Minted bars in grams can range in weight from 0.3 g to 1000 g.



Metalor  
Switzerland



Commerzbank  
Germany



Tanaka  
Japan



Rand Refinery  
South Africa

**EXAMPLES OF PACKAGING**

Minted bars are often sealed in secure containers.



Emirates Gold  
United Arab Emirates



Banks in India



Valcambi  
Switzerland

More than 100 tonnes of minted bars are normally produced each year by accredited and non-accredited bar manufacturers worldwide.

Refer to disclaimer on website: [www.goldbarsworldwide.com](http://www.goldbarsworldwide.com)

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