

In the United Kingdom, a purchaser of gold, silver or platinum is fortunate in having the advantage of a unique protection - the hallmark. With few exceptions such as very small articles or antiques, it is unlawful for a trader to describe an article as gold, silver or platinum unless it bears a hallmark. Under the British hallmarking system, precious metal articles are tested independently of the manufacturer at one of the four official Assay Offices at London, Birmingham, Sheffield and Edinburgh, and only if the metal is of the legal standard of purity are they stamped with the prescribed marks.

Standards for gold and silver articles were first set in 1238, but it proved difficult to ensure that these standards were observed and therefore a statute was passed in 1300 requiring silver articles to be of the sterling standard, assayed by the Goldsmiths' Guild and marked with the leopards head before leaving the workers premises. The Goldsmiths' Guild had its responsibility for assaying and marking

confirmed by Royal Charter in 1327. The Guild is now known as the Goldsmiths' Company and is still responsible for the London Assay Office.

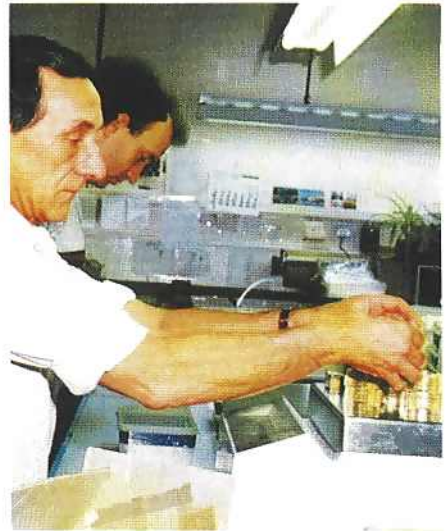
In 1363, makers were ordered to stamp their distinguishing marks alongside the leopards head. Despite this monitoring of makers premises, sub-standard articles were still in circulation and to overcome this problem the Company appointed a salaried assayer in 1478 and compelled makers to bring their wares to Goldsmiths' Hall for assaying and marking, hence the word hallmark. In the same year the Company introduced the date letter mark, which changes each year in order that the Assayer responsible could be identified in any subsequent dispute. A date letter mark is still used by all the British Assay Offices and is of great value to collectors of antique silver although this spin-off was not anticipated at the time of its introduction.

Presently the London Assay Office receives in excess of 300 parcels of work daily, containing anything from

Checking items on receipt at the Assay Office



Weighing items on receipt





Counting chains on receipt

1 to 20,000 articles from any of its 11,000 registered sponsors (i.e. manufacturers or importers). Each registered sponsor has a unique sponsor's mark, which must be stamped on the article before hallmarking. Many sponsors request the Assay Office to stamp the articles with their mark on their behalf. Each parcel is acknowledged by the issue of a numbered ticket, and that number entered in the Assay Office computer. The number uniquely identifies the parcel, and since each operation on a particular parcel is also logged, the status of any particular parcel can be instantly determined.

The customer is expected to include in his parcel a hallnote listing the parcel's contents which is checked against the actual contents, and the quantity, type and weight noted. Articles may be submitted in any state or form and range from part-finished UK manufactured products to diamond set jewellery ready for sale. For part-finished goods, all the parts needed for completion must be present. If this is not the case the customer must supply the missing parts before the work can proceed.

Sampling

Whilst necklets, bracelets and rings constitute 60 per cent of the articles received daily, the total range of pieces submitted, and the variation in number of articles per packet make it impossible to do more than outline the sampling frequency and method. A knowledge of jewellery manufac-

ture is essential so that the number of samples is kept to a minimum. Where batches of identical articles are involved, a statistical sampling for fire assay and touchstone tests is used.

The touchstone, combined with the reaction of the streak of nitric acid solution of differing strengths, is a powerful tool in the hands of an experienced person. The accuracy of this test is limited, but its use ensures that the sample taken for fire assay is gold of the same nominal standard. It helps to reveal variations in the standards of the alloys used for the different parts of an article, such as findings. The touchstone can also help to distinguish between white golds based on palladium or nickel and, incidentally, to prevent platinum settings from being assayed by accident as if they were gold. Good touchstones are difficult to obtain, but with care they last for many years.

Sampling for fire assay normally requires removing 50-250 mg of representative material from the article. A triangular steel scraper is the commonly used tool for this purpose, since it most readily penetrates surfaces which are contaminated or have been enriched by plating or chemical attack. 'Improvement' of the surface of low standard (375) gold alloys is becoming so common that modern instrumental methods which only test a thin layer on the surface are inappropriate.

Surfaces of different profiles can be sampled using scraper of the appropriate shapes. Moreover, the damage to the article caused by a scraper in skilled hands is most readily rectified.

In addition, slight variations in behaviour during scraping can indicate differences in alloy compositions, and also identify the presence of permitted rhodium plating.

The difficulties caused by surface variations make a sample cut from the bulk of the article preferable. Obvious candidates are casting sprues or ear-ring wires which have deliberately been left too long. With wrought or finished work, one or more representative pieces in a consignment may have to be cut in the process. With multicolour gold necklaces this cannot be avoided if samples of different colour units, the end and bolt rings, marking plates, pin wires, and mesh supporting cores are to be obtained. As many as forty samples may be taken from a mixed chain parcel.



Sampling a gold ring by scraping



Sampling the yellow gold edging of a tricoloured bracelet



Removing the sprue from a cast ring to provide a sample for assay

Assaying

Fire assay is the only method capable of meeting UK legal requirements for gold.

These samples are each wrapped separately and identified only by the packet number given when the work was received. They are then sent by pneumatic tube to the assay laboratories, which are physically separated from the sampling and marking areas and receive no information whatsoever on the customer whose work is being tested. In an average day they will receive and assay 1,000 such samples, and at busy times this can exceed 1,500.

The fire assay or cupellation method is based on the centuries-old gold refining process, for it depends on recovering the fine (pure) gold in a sample and relating this to the original weight. With careful attention to detail, an accuracy of one part in 3,000 can be readily achieved on 200 mg samples through the use of electronic balances capable of weighing to 0.01 mg, as well as specially designed thermostatically controlled electric furnaces. Such precision has no equal in modern analytical chemistry.

The procedure involves weighing the sample, which is normally in the range of 50-250 mg, and wrapping it in 4g of thin lead foil with sufficient pure silver to bring the ratio of gold and silver in the total to 2:5. This and other lead wrapped samples along with standard check samples are processed in batches of 96. The identity

of each sample is indicated by its position in an 8 x 12 array matching the sample papers, bearing the original sample number, arranged on a special board. The batch of samples is loaded onto an 8 x 12 array of magnesite cupels in a furnace at 1,100° C. The position of the sample in the array is maintained in subsequent operations. After 20 minutes, the base metals associated with the gold are extracted into the molten lead and absorbed into the cupel leaving a silver bead containing all the original gold. This bead is rolled into a thin strip, coiled into a spiral and immersed in hot 3M nitric acid to eliminate the silver. After annealing, the residual gold coil is weighed. Since all balances are linked to the computer, the gold content is immediately calculated and the result printed simultaneously in the laboratory and in the marking department. The check samples are considered an essential part of the assay because they provide independent evidence of its accuracy.

This has proved to be an effective and economical procedure for dealing with a large number of samples of expected gold content but of unknown composition on a continual batch basis. It is recognised by the International Convention on Hallmarking as the reference method of gold analysis. As the hallmark is a guarantee of minimum gold content, using the reference method for all samples un-

derwrites that guarantee. Other methods of gold analysis, such as coulometric, X-ray fluorescence and inductively coupled plasma spectrophotometry have been developed within the industry over recent years. Apart from the commercial considerations of capital and running costs, and speed of analysis, the technical merits of accuracy and precision, sensitivity to sample size, pre-preparation, and interference effects of the non-gold constituents in the sample have to be taken into account in relating the results obtained back to the reference cupellation method.

In addition to assaying precious metal articles as required by law, the Office also undertakes analyses of precious metal scrap ingots and other samples of precious metal alloys from the industry.



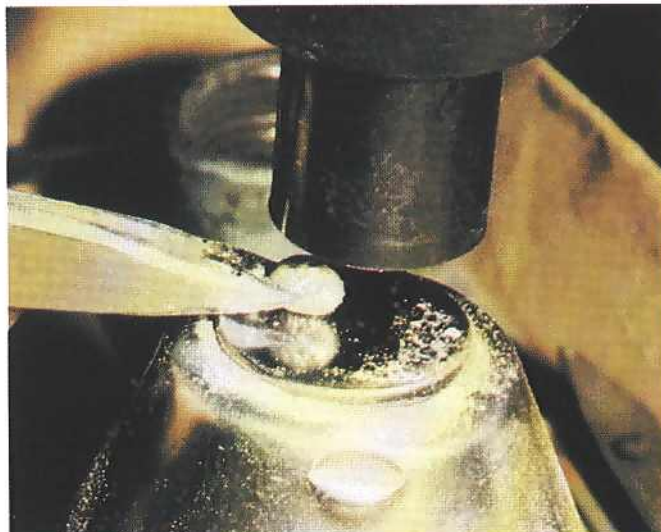
Preparing a gold sample for fire assay with the aid of computer-controlled electronic balances



Adding silver to the weighed gold sample in its lead foil wrapper



96 samples at a time are placed in preheated magnesite cupels in an electric furnace. The base metals will be extracted into the cupel



Flattening the gold-silver bead



Removing the parting tray containing 96 cornets from the boiling nitric acid used to dissolve the silver



Removing one fine gold cornet from a parting thimble in readiness for reweighing

Hallmarking

The small percentage of pieces which fail to pass assay is often due to poor quality control of the alloy or findings used. Occasionally problems are encountered with imported goods because the exporter fails to appreciate that the UK law also specifies solder quality.

The marks, which vary in height from 0.5 to 4.5 mm, cannot be applied without the maker's or sponsor's mark.

Most of our registered sponsors ask us to strike this mark, based on the initials of their company, at the same time as the hallmark itself. This comprises a standard mark indicating the gold content and, for British goods a crown, the Assay Office's own mark of a leopard's head and a letter indicating the year in which the mark was applied.

Increasing numbers of pieces are now receiving a "scales" mark instead of

the crown. This indicates that the piece meets the (usual) higher standards of the International Convention and can be sold without further national marking in eight countries.

Considerable care is taken to ensure that marking does not damage or distort the articles. By supporting the piece immediately beneath the mark with an appropriately shaped anvil and by mounting the steel punch in the correct type of press, we can

The 1985 hallmark for 750 standard gold (with London Assay Office sponsor's mark – 'LAO')



A Vienna Convention mark for 750 gold (with London Assay Office sponsor's mark)





A specimen general purpose set of tools used to support jewellery and reduce damage in marking (punching)

usually avoid the inherently more variable, labour-intensive and skilled traditional hand-held punching. These presses range from manually operated fly and arbour presses to a range of pneumatic, hydraulic or reciprocating types. For medallions, a roll press is needed to impress the mark on the rim.

Although there is never more than one full hallmark on an item, additional marks may be placed on those

parts which can be easily separated from the article. Some pieces may be too small or too fine to take a mark, but ingenuity and our experience ensure that these are few.

Once marked and identified as having passed assay, the articles are subjected to our own quality control to ensure that all marks have been correctly applied and that, except for minimal weight losses for the assay samples, the whole packet is being

returned. The parcel is then repacked, usually in its original box, and posted or stored pending collection on presentation of the original numbered receipt. The customer can determine whether his work is ready for collection by asking us to search our computer records.

The whole sequence of operations takes from one to three working days depending on the time of year and the articles involved. As an example of independent quality control in the interests of the consumer there are few equals.

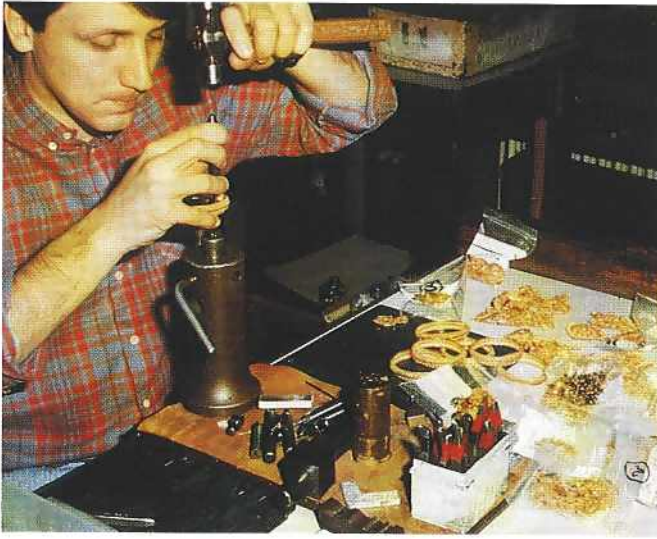
The manufacturer or importer is always invited to discuss any problems posed by hallmarking with staff in the Office. The rules laid down in UK law are applied without distinction, and are accessible to all. The London Assay Office was set up to help reputable manufacturers comply with the law and it endeavours to continue the traditions established over the centuries in Goldsmiths' Hall.

A swan-neck-shaped punch is used to apply a satisfactory mark inside a gold ring



Marking gold chains on an electric reciprocating press





Striking a mark on diamond-cut jewellery by hand



The final quality control stage – checking that the mark has been correctly applied

D.W. Evans
Deputy Warden
The Worshipful Company
of Goldsmiths
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Office