The Analysis of Victoria Crosses in New Zealand

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Abstract

The Victoria Cross is the most important medal awarded for valour in time of war in the British Commonwealth. It is arguably also the most unusual in that it was based on design work by the reigning monarch Queen Victoria and her consort Prince Albert. The crosses were cast from metal from two cannons captured at Sebastopol in 1856 and not some noble metal. The medal commands very high prices if sold and thus attracts the skills of forgery. The Victoria Crosses in New Zealand were examined by X-ray fluorescence spectroscopy and the data was compared with previously obtained information from the Australian War Memorial collection. The comparative studies allowed the issue of certificates of authenticity to the New Zealand institutes and lending bodies.

Introduction

In the British Imperial Honours and Awards system the Victoria Cross (VC) is the highest award for bravery in the face of the enemy. This fact, plus the high monetary value of the VC[1], is common knowledge and indisputable. Other facts about the VC are mixed up with a mythology that is difficult to dispel.

Queen Victoria and Prince Albert took a close personal interest in the design and conditions of the VCs award. The responsibility for the manufacture of the medal was given to the established jeweller, Hancocks of London. Crook (1975) suggests it was probably designed by one of their employees,
H. Harmstead. See Figure 1 for Obverse (front) and Reverse (back) of a VC.

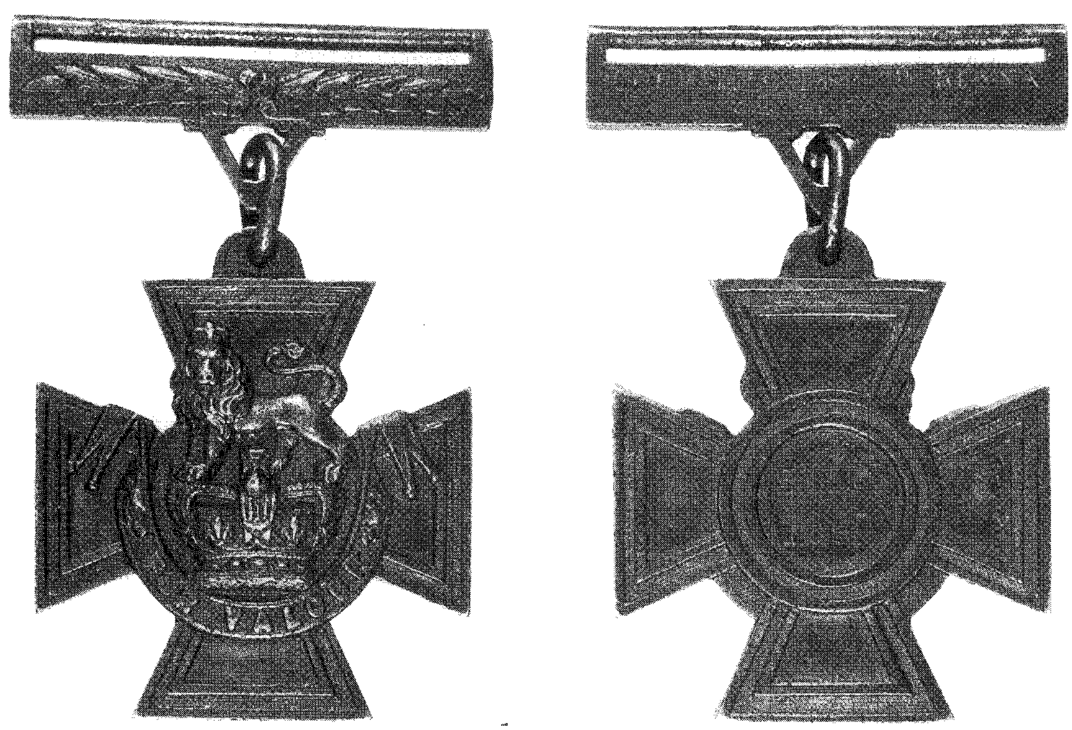

Figure 1. Illustration of Obverse and Reverse of a Victoria Cross

[1] On 10 August 1993 *The Canberra Times* reported the sale of the Wheatley Victoria Cross Group (VC and seven other medals) for A$165 000.

Hancocks remain to this day the sole supplier of the Victoria Cross. All VCs are made from the cascabels removed from two cannons captured from the Russians by the Royal Navy at the Siege of Sebastopol. A cascabel is the rounded protrusion located at the breech end of a cannon and is used to secure recoil ropes.

Most medals are made by a method known as striking. A blank piece of metal is positioned between two dies that have either sudden impact or immense pressure applied. This action stamps the details on the medal. The VC, however, is made by pressing a master die into special sand contained in a box. Molten metal is poured (cast) into the impression left by the die. The medals are cast in groups of six in a star shape.

The Royal Warrant of 29 January 1856 which instituted the award of a VC was made retrospective to 1854 and the first presentation was on 26 June 1857 when Queen Victoria invested 62 recipients. Since then, 1354 VCs have been awarded and the Australian War Memorial (AWM) has in its collection VCs earned in the Crimean War (1854-1856), the 2nd Boer War (1899-1902), 1st World War and Russia (1914-1919), 2nd World War (1939-1945) and Vietnam (1962-1973). Some 91 VCs were won by members of Australian Forces and five by Australians serving with British Forces. Of these 96 VCs, 54 are in the AWM's collection.

In 1988 the AWM management agreed that a definitive method of authenticating and individually identifying the Victoria Crosses in the collection was necessary. Consequently, the Conservation Section of the AWM developed an analytical program, in collaboration with Associate Professor Dudley Creagh of the Australian Defence Force Academy (ADFA).

The 54 VCs in the AWM's collection have been analysed and the Royal Armouries HM Tower of London have collaborated in a wider project by analysing many in England. The Royal Armouries also are the custodians of the cannon from which material the VCs are made. Our data base now includes information on that material and on the most recent VCs awarded during the Falkland Islands Battle in 1982.

The historical record of the manufacture of the VC is decidedly muddled, with a number of authoritative documents giving quite contradictory information.

Risk (1965) describes the medal as having "the single word VALOR" while Reader's Digest (1965) refers to it as "struck from metal guns". Purves (1983) quotes "The cross was traditionally and for many years manufactured from the bronze of guns captured in the Crimea, but this supply was exhausted in March 1942". Wigmore (1986) states "Initially VCs were fashioned from small ingots smelted from the cascabels of two Russian bronze guns. During the 1939-45 war the remaining stock metal was destroyed by enemy air action so the cascabel was cut from another Russian gun captured at Sebastopol". More recently on compact disc (1992) we find that, "The bronze for this rather plain decoration came from a Russian cannon captured during the Crimean War."

In 1995 the author was awarded an ANZAC Fellowship to study VCs in New Zealand. This provided an opportunity to increase knowledge of the VC and to strengthen the cultural bonds between like institutions in Australia and New Zealand. According to Bryant (1972) some 28 VCs were awarded to New Zealanders. These include the earliest to Charles Heaphy won in 1864 and the latest to Lloyd Trigg won in 1943 and of course the double winner Charles Upham 1941 and 1942. As well as providing extra data which will add to a final definitive publication on the technology of the VC, the study made it possible to provide statements of authenticity for the VCs which were examined.

Materials and Methods

VCs have such high monetary value and are so rare that it is not possible to use any techniques of analysis that could harm the medals in any way. Because of this, methods of analysis chosen were X-ray fluorescence (XRF) and X-ray diffraction (XRD) coupled with standard microscopic examination.

Visual Examination

When a medal is received it is subjected to a rigorous visual examination and recorded using a scientific macro-photography system. The imperfections and irregularities arising from the production method of sand-casting are noted.

The work of the "chaser", whose job it is to chisel the lettering and other surface design into sharp relief and to disguise casting imperfections, can also be evaluated at this stage. The engraved numbers and letters are very closely examined and this engraving, like handwriting is unique. The style of, and the abbreviations used in the engraving are also observed and compared with previously recorded information on other authenticated VCs. The medals are weighed and dimensions noted for further comparative checks - although because of the casting method and material used the mass and dimensions are not rigidly fixed.

XRF and XRD Analysis

When primary X-rays from an X-ray source are directed onto a metal sample some of the energy bounces off the sample as secondary X-rays. These secondary or fluorescence X-rays cover many wave lengths that are produced by the different elements in the sample. The secondary X-rays are received by a diffraction crystal and then are collected by an X-ray detector. The detector reads the specific wave lengths of the diffracted X-rays that correspond to particular elements in the sample. the amplifier, counter and computer then can produce semi-quantitative results by analysing the energy level that characterises the element, and the intensity that indicates the abundance of the element. These may be given as a percentage of the whole sample area tested or as parts per million (ppm) in the case of minute amounts.

Figure 2 shows this procedure in schematic form.

The X-ray equipment in New Zealand at the Auckland University Geology Department was a Siemens Sequential X-ray Spectrometer SPECTRA 3000. The software program linked to the spectrometer was Siemens SEMIQUANT SSQ 300 Version 2.0. The equipment was used under the tutelage of Mr John Wilmshurst. With the SSQ 300 it is possible to analyse elements from atomic numbers 6 to 92 (Carbon to Uranium) using analysis crystals of Lithium Fluoride (LiF 110), LiF 100, and Pentaerythrite (PET). The program is easily modified to measure only elements of interest. The system identifies more than one line of energy to ensure the presence of the element and automatically evaluates the concentration.

Sample Preparation

The samples are held in a titanium cup shaped container with a hole in the bottom. A plate with a 15mm diameter hole was made to fit the bottom of the cup. The size of the hole was determined by the circular area on the reverse of the VC (Figure 1). This area was selected to provide the flattest area for analysis to facilitate reproducibility. By analysing this circular area an average composition for the entire circular area of some 1.54 sq cm was obtained. This technique is superior to electron probe micro-analysis (EPMA) since the inherent variations of composition may give erroneous results due to

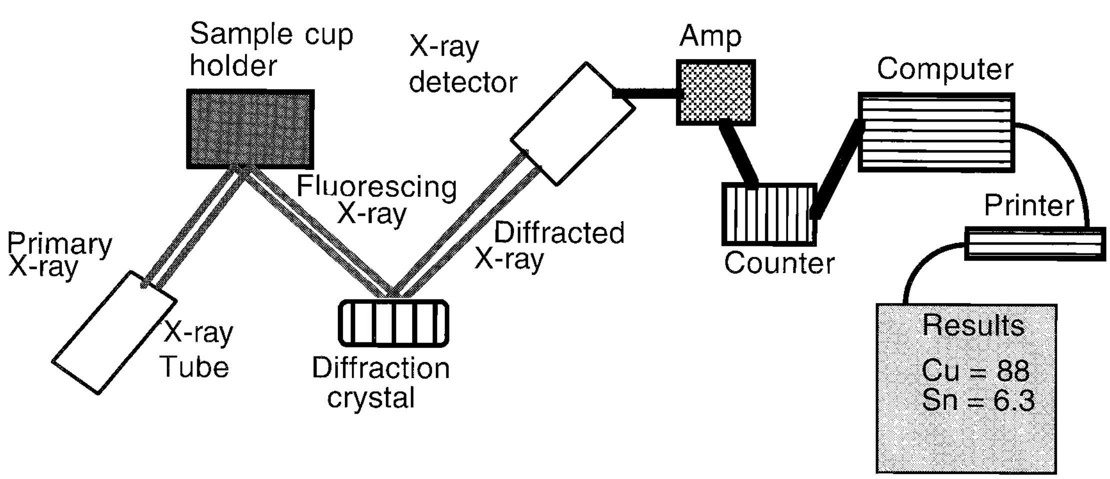

Figure 2. Schematic of XRF analysis technique

Sample Id.: NICOPPERNT **Measured on 29 Feb 1996 10:10**

Ni	Cu	Fe	Sn	Cr	Zn
%	%	%	%	%	%
63.9	33.2	2.67	0.0790	0.0490	0.0148

Sum of concentrations: 100.00%

Compton line Rh KA1C - Computed/Measured: 0.784 - Measured: 2.364
Compton line Rh KB1C - Computed/Measured: 0.758 - Measured: 0.656

Sample Type:	metal vc
Sum of other Elements:	0.00%
Absolute Threshold:	0.0050%
Relative Threshold:	2.0 * Statistical Error
Intensity Scaling:	1.0000
Normalisation Factor:	2.7963

Figure 3. Concentrations of elements shown as percentages present in the Nickel/Copper standard.

the very small areas measured in that type of analysis. Indeed, using EPMA a VC could be proved to consist of a single element.

As a cross check, several reference standards were also analysed. These were the US Department of Commerce, National Bureau of Standards for optical emission and X-ray spectroscopic analysis of NBS1118 (aluminium brass) and NBS1101 (cartridge brass). An authorised VC copy manufactured for public sale was also analysed. By comparing results with those of the standards a more direct comparison of data was obtained giving greater confidence in the results.

A standard or a VC is placed in the sample cup and then loaded into the spectrometer cabinet. Once the cabinet is closed and the analysis program set in motion by the computer the cup is automatically lowered into the vacuum chamber. The chamber is then air evacuated to reduce possible sources of interference for the X-rays. Once the analysis is completed the X-ray emitter is disabled and the cup raised from the vacuum chamber to allow safe manual unloading and reloading.

The data on the sample is then extracted from the computer and printer. The measured data is interactively evaluated. The print-outs contain information on the element, the concentration (in percentage or ppm) and the counting statistical error. The tabulated data (Figure 3) shows the elements present and the amount of that element detected in a Cupro-Nickel metal standard.

Composition of VCs

The major elements identified in the medals are copper (Cu), zinc (Zn) and tin (Sn). Most classifications of alloys give the following broad specification for the copper alloys of bronze, gunmetal and brass:

Bronze:	Cu 90%, Sn>6% + other elements
Gunmetal:	Cu 88%, 8 to 10% Sn, 2 to 4% Zn
Brass:	60 to 70% Cu, Sn<2%, 30 to 40% Zn

Medals awarded in the Crimean War, the Maori Wars, the Indian Mutiny, the Boer War and the early part of the First World War have copper and tin compositions that are typical of a bronze. Later in the First World War and continuing through to the present day the composition is more consistent with a brass. The author has observed some exceptions to this in the Australian VCs; three awarded to Australians serving in the RAF/RAAF during the Second World War have characteristics similar to those awarded in 1914/15. Unfortunately no airforce VCs were available for examination in New Zealand so that comparison could not be pursued.

Results of Analysis of VCs in New Zealand

Fifteen VCs were examined:

a. Four from the Auckland Museum's collection: McKenna 1863, Heaphy 1864, Bassett 1915 and Sanders 1917;

b. Eight from the Queen Elizabeth II Army Memorial Museum at Waiouru: Diamond 1857, Hardham 1901, Frickleton 1917, Judson, Laurent, and Storkey 1918, Upham 1941 and Bar 1942, and Elliott 1942;

c. Two from Canterbury Museum, Christchurch: Nicholas 1917 and a War Office specimen VC donated in 1920; and

d. One privately owned (currently displayed in Henderson RSA Club) VC copy engraved 1914 and named Dvr.Luke.F.

Each of the mentioned institutions have been issued with authentication statements for their individual VCs. Some have also been supplied with other information that may be of interest, about the morphology of some of the VCs in their care. The main bulk of the analytical information has of course been totally restricted to myself and Dudley Creagh and will remain so for security reasons. Knowing the exact compositions of the medals would make it relatively easy for a prospective forger to duplicate the metallurgical composition, which would be the first step to "producing" one of the few missing VCs.

It is important to note that when medals and other items of value are examined it is essential that subjective matters such as style, composition and form play almost as significant a role as the quantitative metallurgical tests in forming an opinion as to an objects authenticity.

The major elements of these VCs are recorded in Table 1 and are represented in graphical form in Figure 4.

Figure 4 plots the percentage composition of the major constituents Cu, Zn and Sn, as a function of the date of the action for which the medal was awarded. This method of data presentation is problematic in that there were sometimes long delays (up to three years) in the actual presentation of the medal to the recipient.

This method of presentation graphically illustrates the variation of the composition of the VCs since they were first awarded.

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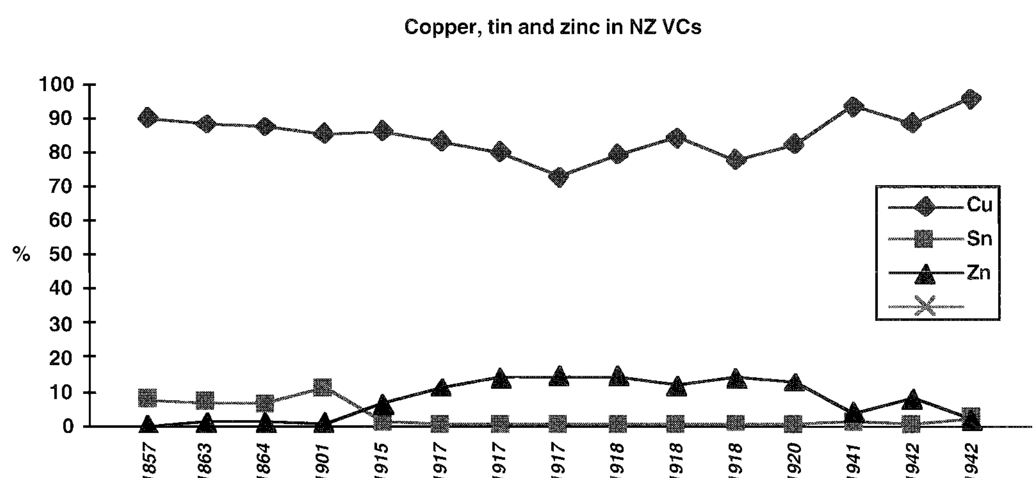

Figure 4. Plotted percentage composition of 15 VCs examined in New Zealand.

Name	Date	Cu%	Sn%	Zn%
Diamond	1857	90.4	7.7	0.05
McKenna	1863	88.5	6.3	0.9
Heaphy	1864	87.8	6.5	1.15
Hardham	1901	85.7	11.0	0.6
Bassett	1915	86.2	1.2	6.5
Sanders	1917	83.2	0.2	11.2
Frickleton	1917	80.3	0.2	14.0
Nicholas	1917	73.1	0.2	14.5
Judson	1918	84.4	0.4	11.9
Laurent	1918	77.9	0.5	14.0
Storkey	1918	79.5	0.2	14.5
Un-Issued	1920	82.6	0.2	12.7
Upham	1941	93.8	0.9	3.6
Upham BAR	1942	88.6	0.3	7.88
Elliott	1942	95.8	2.2	1.8
Luke (Copy)	1914	90.3	0.1	9.55

Table 1. Cu, Sn and Zn percentage composition in New Zealand Victoria Crosses.

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Discussion

The existence of the two distinctly different classes of metal alloy in the Victoria Crosses has led us to look more closely at the historical record. There are, indeed, two cannons from which the material has been taken to make VCs. Both cannons are now situated at the Royal Artillery Barracks in Woolwich, England. Both have had their cascabel removed. The remains of one cascabel (shown on stocktake docket as 26 pounds weight) is in the control of the Royal Army Ordinance Corps at Donnington, England. The cannons are different to each other in appearance, and previous writings have indicated that they are Russian in origin because they were captured at Sebastopol from the Russians. However, their composition is not consistent with European guns of the 18th and 19th centuries. Close examination of one of the cannons reveals inscriptions, now totally illegible, in archaic Chinese. In light of that it now seems reasonable that the cannons are of Chinese origin and were probably cast in the 18th century. The Chinese inscriptions may have caused the belief that these were cannons from the Boxer Rebellion (1900-1901), a belief that is totally without foundation since the cannons in question have been in the control of the Royal Armouries from before that date. The remains of the cascabel held at Woolwich show that the shape was not spherical, as was common in European cannons but was originally onion shaped, a typical asiatic cannons addition.

Some of the early founders referred to the material they were casting the VC from as "mucky metal" which is an indication that it was rich in impurities and that it may have been difficult to achieve good castings. This description would certainly add weight to the argument for the inconsistencies in composition and the imperfections in surface finish of the medal.

Conclusions

The examination of the New Zealand VCs has not revealed any spurious medals but it has allowed us to add very valuable information to the data base for our larger project. For example, we and our collaborators of the Royal

Armouries had never been able to study an example of a VC and Bar. One possibly spurious VC was mentioned as a potential study piece but the public institution that holds it declined to have it tested.

The Upham VC and Bar are only the third example of the double award and the study of them proved most worthwhile. The metallurgical differences between the medal and the bar points to the casting of the two items at different times. The bar contains similar metal to that used in 1917-18 while the medal has similar composition to others from late 1943. Crook (1975) reveals the strange tale of the Upham VC, which I have tried to simplify by reference to the issued medals as VC-1, VC-2 etc. A Victoria Cross (VC-1) was prepared and sent to New Zealand in 1941, but before it could be presented, Upham became a prisoner of the Germans. Upham was decorated with a duplicate (VC-2) in May 1945 by King George VI, the original (VC-1) being returned to the War Office in England a month later. In September 1945, Upham, now back in New Zealand was gazetted for a bar to his VC. In October 1945 the War Office sent another VC (VC-3), with bar, both engraved, to New Zealand. This new insignia was presented by the Governor General of New Zealand to Upham and the duplicate (VC-2) without bar was returned to London in April 1946. The King suggested that the returned cross (VC-2) that he had presented, should have a bar fitted and this should be sent to New Zealand and exchanged for VC-3 and bar. Hancocks pointed out that it was not customary to alter an inscription on a VC and that they would engrave the date (upon which the bar was won) on the bar itself. There is no record that this insignia (VC-2) with new bar ever went to New Zealand. In 1957 the then Military Secretary wrote to Upham regarding a VC (VC-2) and Bar inscribed with Upham's name he had in his safe. Upham declined the offer to exchange the insignia he had (VC-3 and bar) for the pair (VC-2 and bar) rediscovered in London. Upham had in fact transferred the bar he had been invested with by the G-G to the original cross (VC-2) he had received from the King. The insignia (now known to be VC-3) still in London were returned to Hancocks, the cross to have the engraving erased and to be returned to stock. Hancocks were left to deal with the bar as they saw fit.

The Upham VC has a similar composition to 1943 material which puts it two years after the award winning event. It obviously took some of the awards a long time to get out to the colonies or for the recipient to travel to England for investiture. For instance, Australia's first VC presentation was to Frederick Whirlpool on 20 June 1861, three years after he won the award on 2 May 1858 in the Indian Mutiny.

The Luke authorised copy was interesting in that the engraving style is consistent with the early First World War style and is a good example of square cut burin work, although the metallurgy and morphology are instant pointers to cheaper replication.

The unnamed 1920s War Office issued Canterbury Museum medal is undoubtedly genuine. Because of the very high risk of such a piece being fraudulently engraved if stolen or lost, and then appearing on the market as one of the unaccounted for VCs, I recommend that it be treated as being of equal value to the highest valued medal in the VC lists and be given security accordingly.

Primarily because of the unusual material used for casting the VCs each one is individual in some respect. It would seem fitting that a unique act of heroism is commemorated by the award of a medal which itself is unique.

Acknowledgments
The author wished to acknowledge the assistance given to him in the pursuance of this project by the staffs of:

* The Geology Department, University of Auckland, for the use of the XRF Spectrometer and for technical and administrative assistance of the highest order and for friendship and hospitality.

* The Queen Elizabeth II Army Memorial Museum, Waiouru, for the access to their collection of VCs, for security arrangements and for their true military style hospitality.

* The Auckland Museum for allowing me access to their newly exhibited VCs, for their

curatorial, conservation and registration staff involvement and for the promise of more joint projects in the future.

* The Canterbury Museum, Christchurch for their curator personally transporting their VCs to me, in Auckland, for the analysis project.

* Special thanks to Mr Alan Atfield and the Henderson RSA Club for the opportunity to examine their VC copy.

I would like to especially thank Elly-Ann Pritchard, of the NZ Department of Internal Affairs for her prompt and friendly co-ordination of the 1995 ANZAC Fellowships.

A final expression of gratitude, to my colleague Professor Dudley Creagh for his expertise and support in this project.

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Biography

John Ashton has worked as a metals conservator from 1982 to 1995 and is now the Senior conservator of Objects, Australian War Memorial. John was awarded a 1995 ANZAC Fellowship to study the metallurgy of Victoria Crosses in New Zealand.

Appendix 1
to VC analysis report
ANZAC Fellowship 1995

Metallurgical standards used in XRF analysis of New Zealand Victoria Crosses.

The following information is copied directly from the NBS certificates.

US Department of Commerce
National Bureau of Standards
Washington, DC 20234
Provisional certificate of Analyses (Revised) for NBS1101 Cartridge brass standards and NBS1118 Aluminium brass

Optical emission and X-ray spectroscopic analysis

Element	NBS1101	NBS1118
Copper	69.6	75.1
Zinc	30.2	21.9
Lead	0.05	0.02
Iron	0.037	0.06
Tin	0.016	
Nickel	0.013	
Aluminum	0.0006	2.8
Antimony	0.012	0.010
Arsenic	0.009	0.007
Beryllium	0.0005	
Cadmium	0.005	
Manganese	0.005	
Phosphorus	0.002	0.13
Silicon	(.005)	0.002
Silver	0.003	
Tellurium	0.001	

Values in parentheses are not certified, but are given for information on the composition.