UNITED STATES DEPARTMENT OF COMMERCE
WASHINGTON 25, D.C.

National Bureau of Standards Certificate of Analyses

Standard Sample 158A

Silicon Bronze

ANALYST	COPPER Electrolytic	SILICON	ZINC ZnS–ZnO	IRON	MANGANESE Photometric	TIN $SnCl_2$–KIO_3	ALUMINUM	LEAD	NICKEL Photometric	PHOSPHORUS Photometric
1	[a] 90.94	[b] 3.01	2.09	[c] 1.24	[d] 1.11	[e] 0.96	[f] 0.46	[g] 0.093	[h] 0.0011	[i] 0.027
2	[j] 90.87	[k] 3.00 [l] 3.08	[m] 2.01	[c] 1.18	[n] 1.13	[o] .98	[p] .48			
3	[q] 90.95	[r] 3.04	[s] 2.11	[c] 1.25	[n] 1.11	[t] .96	[u] .44	[v] .10	[h] .0011	[w] .027
4	[q] 90.93	[l] 3.02 [x] 3.03	[y] 2.09	[z] 1.23	[n] 1.11	[t] .96	[z1] .46	[v] .10	[h] .0007	[w] .025
5	[z2] 90.95	[z3] 3.00	[z4] 2.08	[z5] 1.24	[z6] 1.10	[z7] .94	[p] .45	[z8] .096		
Average	90.93	3.03	2.08	1.23	1.11	0.96	0.46	0.097	0.001	0.026

[a] Five-gram sample dissolved in 40 ml of HNO_3 (1+1). Solution digested on a steam bath overnight, filtered and the precipitate washed with hot HNO_3 (1+99). Precipitate treated with HNO_3–$HClO_4$–HF–HBr and residual solution combined with the first filtrate. Two drops of 0.1 *N* HCl added, solution diluted to 300 ml and electrolyzed overnight, using a current density of 0.5 amp/dm². Residual copper and lead in the electrolyte precipitated with H_2S and determined by electrolysis.

[b] Double dehydration with $HClO_4$, and a Na_2CO_3 fusion followed by double dehydration with H_2SO_4.

[c] $SnCl_2$–$K_2Cr_2O_7$ method.

[d] Persulfate-arsenite method with potentiometric titration.

[e] Tin reduced with lead and titrated with KIO_3 standardized with high-purity tin.

[f] Copper in a 2-g sample removed by electrolysis of a HNO_3–HF solution. Mercury cathode separation then made in sulfate solution followed by H_2S separation in 0.01 *N* acidity. Sulfides filtered off, and MnO_2 removed with persulfate in dilute acid solution. Aluminum precipitated with HN_4OH twice and ignited to Al_2O_3.

[g] Weighed as PbO_2.

[h] Dimethylglyoxime-photometric method.

[i] Phosphomolybdenum blue method.

[j] See ASTM method E36–45.

[k] Photometric method.

[l] H_2SO_4 dehydration. See ASTM method E54–49.

[m] Copper removed by electrolysis and electrolyte evaporated to fumes of H_2SO_4. Solution treated with an excess of NaOH and filtered. Zinc determined in the filtrate by electrolysis.

[n] KIO_4-photometric method. See ASTM method E62–56.

[o] Tin reduced with sodium hypophosphite and titrated with iodine.

[p] Mercury cathode-Al_2O_3 method. See ASTM method E54–49.

[q] Direct electrolysis of a 2-g sample in an HNO_3–HF solution containing a small amount of added lead.

[r] Double dehydration with H_2SO_4, and a Na_2CO_3 fusion followed by double dehydration with H_2SO_4.

[s] $ZnHg(CNS)_4$ method.

[t] Tin reduced with aluminum and titrated with KIO_3 standardized with high-purity tin.

[u] Mercury cathode - 8 - hydroxyquinoline - gravimetric method.

[v] Dithizone-photometric method.

[w] Molybdivanadophosphoric acid method.

[x] Molybdisilicic acid-photometric method.

[y] Zinc extracted as thiocyanate and titrated with sodium ethylenediaminetetraacetate.

[z] Iron titrated with $TiCl_3$.

[z1] Copper removed by electrolysis of a HNO_3–HF solution. Silicon in the electrolyte removed with H_2SO_4–HF treatment, tin with HBr, and manganese with $(NH_4)_2S_2O_8$. Filtrate electrolyzed in a mercury cathode. Aluminum precipitated with NH_4OH, ignited to Al_2O_3, and corrected for phosphorus.

[z2] Direct electrolysis of a 2-g sample in an HNO–HF solution.

[z3] $HClO_4$ dehydration.

[z4] Zinc in the electrolyte from the copper determination precipitated twice with H_2S in formic acid solution and ignited to the oxide.

[z5] Iron reduced in a silver reductor and titrated with $Ce(SO_4)_2$.

[z6] $NaBiO_3$ method.

[z7] Tin reduced with lead and titrated with KIO_3. See ASTM method E54–49.

[z8] Lead separated as $PbSO_4$ and weighed as $PbCrO_4$.

Analyst 5 reported 0.089, 0.0016, 0.0013, and 0.0011 percent for lead, nickel, chromium, and silver, respectively, by spectrographic analysis.

List of Analysts

1. Nonferrous Laboratory, National Bureau of Standards, R. K. Bell in charge. Analysis by E. E. Maczkowske.
2. A. W. Young, Bridgeport Brass Co., Bridgeport, Conn.
3. E. L. Smith, H. J. Smith, R. C. Burnham, and A. B. Feest, Chase Brass & Copper Co., Waterbury, Conn.
4. O. P. Case, G. A. Reihl, W. H. Taras, and Kathleen M. O'Brien, The American Brass Co., Waterbury, Conn.
5. K. H. Storks, E. Bloom, Jr., and E. K. Jaycox, Bell Telephone Laboratories, Murray Hill, N.J.

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