

UNITED STATES DEPARTMENT OF COMMERCE  
WASHINGTON

National Bureau of Standards

Certificate of Analyses  
Standard Sample 62c

Manganese Bronze

ANALYST	COPPER Electrolytic	ZINC ZnS-ZnO	ALUMINUM Weighed as Al <sub>2</sub> O <sub>3</sub>	IRON	MANGANESE Persulfate-arsenite	TIN SnCl <sub>2</sub> -KIO <sub>3</sub>	NICKEL Weighed as nickel dimethylglyoxime	LEAD Weighed as PbO <sub>2</sub>	SILICON
1.....	<sup>a</sup> 59.16	37.25	<sup>b</sup> 1.22	<sup>c</sup> 0.74	<sup>d</sup> 0.66	<sup>e</sup> 0.39	0.28	<sup>f</sup> 0.24	<sup>g</sup> 0.068
2.....	{ <sup>h</sup> 59.14 <sup>i</sup> 59.15 }	37.25	<sup>j</sup> 1.21	<sup>k</sup> .75	1.65	<sup>m</sup> .40	.29	<sup>n</sup> .23	<sup>o</sup> .067
3.....	59.16	37.22	<sup>j</sup> 1.22	<sup>p</sup> .73	<sup>q</sup> .66	<sup>r</sup> .39	.29	.24	<sup>u</sup> .073
4.....	<sup>i</sup> 59.19	37.25	<sup>t</sup> 1.19	<sup>u</sup> .74	.66	<sup>v</sup> .39	<sup>w</sup> .28	.22	<sup>x</sup> .061
5.....	<sup>x</sup> 59.16	37.24	1.22	<sup>y</sup> .74	.67	<sup>z</sup> .38	.28	.25	<sup>z</sup> .067
6.....	<sup>z</sup> 59.17	37.23	<sup>j</sup> 1.23	<sup>z</sup> .74	<sup>q</sup> .66	<sup>z</sup> .38	.29	<sup>z</sup> .24	<sup>z</sup> .070
range.....	59.16	37.24	1.22	0.74	0.66	0.39	0.28	0.24	0.068

<sup>a</sup> Five-gram sample dissolved in 110 ml of HNO<sub>3</sub> (1+4). Metastannic-acid precipitate filtered off, treated with HNO<sub>3</sub>-HClO<sub>4</sub>-HBr, and the residual solution added to the first filtrate. Two drops of 0.1 N HCl added, solution diluted to 325 ml and electrolyzed overnight, using a current density of 0.5 amp/dm<sup>2</sup>. H<sub>2</sub>SO<sub>4</sub> added to the electrolyte, solution evaporated to fumes of H<sub>2</sub>SO<sub>4</sub>, diluted, filtered, and residual copper precipitated as CuS and determined by the diethyldithiocarbamate-colorimetric method.

<sup>b</sup> Five-gram sample electrolyzed in a mercury cathode cell. Electrolyte treated with H<sub>2</sub>S and filtered. Manganese precipitated in the filtrate with (NH<sub>4</sub>)<sub>2</sub>S<sub>2</sub>O<sub>8</sub> and solution filtered. Aluminum precipitated in the filtrate with NH<sub>4</sub>OH and ignited to Al<sub>2</sub>O<sub>3</sub>.

<sup>c</sup> Filtrate from CuS separation (footnote a) boiled to remove H<sub>2</sub>S. Iron oxidized, precipitated with NH<sub>4</sub>OH, reduced with SnCl<sub>2</sub>, and titrated with K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>, using sodium diphenylamine sulfonate indicator.

<sup>d</sup> Potentiometric titration of a 1-g sample.

<sup>e</sup> Five-gram sample dissolved in HCl-HNO<sub>3</sub>, tin precipitated twice with NH<sub>4</sub>OH. Precipitate dissolved in HCl, tin reduced with nickel and titrated with KIO<sub>3</sub> standardized with pure tin. See ASTM Method E54-49, Methods of Chemical Analysis of Metals, p. 267 (1950). American Society for Testing Materials, Philadelphia, Pa.

<sup>f</sup> Lead separated as PbO<sub>2</sub> by electrolysis of a 5-g sample and determined as PbSO<sub>4</sub>.

<sup>g</sup> Double dehydration with HClO<sub>4</sub> with intervening filtration.

<sup>h</sup> Five-gram and ten-gram samples dissolved in HNO<sub>3</sub> (1+2). 3 drops of H<sub>2</sub>SO<sub>4</sub> (1+1) added, solution diluted to 350 ml, and digested 1 hour. Solution filtered and filtrate electrolyzed. Residual copper in the metastannic-acid precipitate separated as sulfide and determined by electrolysis.

<sup>i</sup> Copper deposited in the presence of tin in an HNO<sub>3</sub>-HF solution.

<sup>j</sup> Mercury cathode-NH<sub>4</sub>OH-Al<sub>2</sub>O<sub>3</sub> method.

<sup>k</sup> Iron reduced with H<sub>2</sub>S and titrated with Ce(SO<sub>4</sub>)<sub>2</sub>.

<sup>l</sup> Bismuthate method.

<sup>m</sup> Tin reduced with an iron coil in the presence of added antimony and titrated with iodine.

<sup>n</sup> Same value obtained by the PbSO<sub>4</sub> method.

<sup>o</sup> HCl-H<sub>2</sub>SO<sub>4</sub> dehydration method.

<sup>p</sup> SnCl<sub>2</sub>-K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> method. See ASTM Method E54-49.

<sup>q</sup> KIO<sub>3</sub>-photometric method.

<sup>r</sup> Tin reduced with aluminum and titrated with KIO<sub>3</sub>.

<sup>s</sup> Double dehydration with H<sub>2</sub>SO<sub>4</sub> with intervening filtration. See ASTM Method E54-49.

<sup>t</sup> Aluminon-photometric method.

<sup>u</sup> NH<sub>4</sub>CNS-photometric method.

<sup>v</sup> Tin reduced with iron in the presence of added antimony and titrated with KIO<sub>3</sub>.

<sup>w</sup> Dimethylglyoxime-photometric method.

<sup>x</sup> Two-gram sample dissolved in HNO<sub>3</sub>. Copper in metastannic-acid precipitate recovered by treatment with HNO<sub>3</sub>-HClO<sub>4</sub>-HBr. Solution diluted to 350 ml and electrolyzed 1 hour with a current of 2 amperes, with magnetic stirring.

<sup>y</sup> Iron titrated with Ti<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>.

<sup>z</sup> Tin reduced with iron in the presence of added zinc and titrated with KIO<sub>3</sub>.

<sup>z</sup> Copper deposited in the presence of tin in an H<sub>2</sub>SO<sub>4</sub>-HNO<sub>3</sub>-HF solution.

<sup>z</sup> Iron titrated with TiCl<sub>3</sub>.

<sup>z</sup> Tin reduced with aluminum in the presence of added antimony and titrated with iodine.

<sup>z</sup> Lead separated as PbO<sub>2</sub> by electrolysis of a 2-g sample and determined as PbSO<sub>4</sub>.

<sup>z</sup> Silicomolybdate-photometric method.

List of Analysts

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P.C

A. V. ASTIN, Director.