



# Certificate of Analysis

## Standard Reference Material 1174A

### White Iron

	C	Mn	P	S	Si	Cu	Ni	Cr	V	Mo	Co	Sn	Ti	As	B	Sb	Te
ANALYST	Direct combustion	Persulfate-Arsenite	Photometric	Combustion Iodate titration	Perchloric acid dehydration		Weighed as nickel dimethylglyoxime			Photometric	Photometric Nitroso-R				Distillation-Photometric		
1	3.46	<sup>a</sup> 0.178	<sup>b</sup> 0.167	<sup>c</sup> 0.168	<sup>d</sup> 0.285	<sup>e</sup> 0.168	{ <sup>f</sup> 0.032 <sup>g</sup> 0.034}	<sup>h</sup> 0.018	<sup>i</sup> 0.007	0.007	{ <sup>j</sup> 0.009 <sup>k</sup> 0.008}	{ <sup>l</sup> 0.23 <sup>m</sup> 0.24}	{ <sup>n</sup> 0.011 <sup>o</sup> 0.011}	{ <sup>p</sup> 0.025 <sup>q</sup> 0.022}	0.042	{ <sup>r</sup> 0.17 <sup>s</sup> 0.16 <sup>t</sup> 0.20}	{ <sup>u</sup> 0.068 <sup>v</sup> 0.074}
2	3.46	.179	{ <sup>p</sup> .167 <sup>q</sup> .168}	.169	<sup>d</sup> .282	{ <sup>r</sup> .172 <sup>s</sup> .173}	{ <sup>t</sup> .033 <sup>u</sup> .034}	<sup>h</sup> .017	<sup>i</sup> .008	.009							
3	3.47	<sup>v</sup> .182	.171	{ <sup>w</sup> .169 <sup>x</sup> .168}	<sup>d</sup> .282	<sup>e</sup> .167	<sup>t</sup> .040	<sup>h</sup> .018	{ <sup>y</sup> 0.009 <sup>z</sup> 0.010}	.007					<sup>y</sup> .038		
Average	3.46	0.180	0.168	0.168	0.285	0.170	0.035	0.018	0.008	0.008	0.009	0.23	0.011	0.024	0.040	0.17	0.071

<sup>a</sup> Potentiometric titration.  
<sup>b</sup> Molybdenum-blue photometric method. See J. Res. NBS 26, 405 (1941) RP1386.  
<sup>c</sup> 1-g sample burned in oxygen at 1,450 °C and sulfur dioxide absorbed in starch-iodide solution. Iodine is liberated from iodide by titration, during the combustion, with standard KIO<sub>3</sub> solution. Titer is based on 93 percent of the theoretical factor.  
<sup>d</sup> Double dehydration.  
<sup>e</sup> Diethylthiocarbamate photometric method. See J. Res. NBS 47, 390 (1951) RP2265.  
<sup>f</sup> Photometric method.  
<sup>g</sup> Chromium separated from the bulk of the iron in a 10-g sample by hydrolytic precipitation with NaHCO<sub>3</sub>, oxidized with persulfate and titrated potentiometrically with ferrous ammonium sulfate.  
<sup>h</sup> Vanadium separated as in (g), oxidized with HNO<sub>3</sub>, and titrated potentiometrically with ferrous ammonium sulfate.  
<sup>i</sup> Spectrographic method.  
<sup>j</sup> Sulfide-iodine method. See BS J. Res. 8, 309 (1932) RP415.  
<sup>k</sup> H<sub>2</sub>O<sub>2</sub> photometric method. Cupferron separation after solution of the sample in diluted HCl (1+2). Vanadium separated by treatment with NaOH.  
<sup>l</sup> Distillation-molybdenum blue photometric method. See J. Res. NBS 24, 7(1940) RP1267.  
<sup>m</sup> Polarographic method.  
<sup>n</sup> Polarographic method. See Anal. Chem. 37, 1516 (1965).  
<sup>o</sup> Activation analysis.  
<sup>p</sup> Alkalimetric method.  
<sup>q</sup> Gravimetric method (weighed as Mg<sub>2</sub>P<sub>2</sub>O<sub>7</sub>).  
<sup>r</sup> H<sub>2</sub>S-electrolytic method.  
<sup>s</sup> Neocuproine photometric method.  
<sup>t</sup> Perchloric acid oxidation.  
<sup>u</sup> Vanadium separated with cupferron and determined by FeSO<sub>4</sub>-(NH<sub>4</sub>)<sub>2</sub>S<sub>2</sub>O<sub>8</sub>-KMnO<sub>4</sub>.  
<sup>v</sup> KIO<sub>4</sub> photometric method.  
<sup>w</sup> Gravimetric method. Sulfate precipitated with BaCl<sub>2</sub>, ignited to BaSO<sub>4</sub> and weighed.  
<sup>x</sup> Phosphotungstovanadate photometric method.  
<sup>y</sup> Quinalizarin photometric method.

### List of Analysts

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| 1. E. J. Maienthal, B. B. Bendigo, E. R. Deardorff, R. W. Burke, H. Dilworth, R. K. Wolford, D. A. Becker, G. W. Smith, and J. I. Shultz, Division of Analytical Chemistry, National Bureau of Standards. | 2. R. H. Rouse, Bethlehem Steel Co., Sparrow's Point Plant, Sparrows Point, Maryland.<br>3. M. D. Cooper, R. E. Kohn, W. R. Lee, A. H. Jones, and R. B. Loranger, General Motors Corp., Research Laboratories, Warren, Mich. |
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**SIZE AND METALLURGICAL CONDITION:** Samples are approximately 1¼ in. square and ¾ in. thick; they were chill-cast white by a rapid unidirectional solidification technique with the addition of inoculants, and were given a stress relief heat treatment at 1100 °F for 1 hr, which is below the graphitizing temperature.

**CERTIFIED PORTION:** The certified portion for each sample is that extending upward 5/16 in. from the chill-cast or test surface (the largest surface opposite the numbered surface) as received. This portion only was analyzed in the cooperative program for certification.

<sup>R</sup> Because of the extremely rapid chilling of the samples, some shrinkage cavities exist in the noncertified area, mainly at top center position. These do not extend into the certified area and should not influence the application other than by appearance.

PLANNING, PREPARATION, TESTING, ANALYSIS: The two white cast iron standards, NBS 1174A and 1175A, a high and a low composition alloy, are designed to replace white cast iron standards, NBS 1174 and 1175.

As with the previous two standards, these were melted and cast at the Naval Research Laboratory, Washington, D. C. The details of the preparation and homogeneity testing are described in NBS Misc Publ 260-1, Standard Reference Materials: Preparation of NBS White Cast Iron Spectrochemical Standards, by Robert E. Michaelis and LeRoy L. Wyman, June 19, 1964, pp. 1-31.

Homogeneity testing at the National Bureau of Standards by optical and x-ray spectroscopic analysis was performed by D. M. Bouchette, and chemical analysis by J. I. Shultz. In addition, considerable cooperative testing was performed by W. R. Kennedy, American Cast Iron Pipe Co., Birmingham, Ala.

The chemical methods employed at the National Bureau of Standards for the analysis of the standards are given in NBS Misc Publ 260-6, Standard Reference Materials: Methods for the Chemical Analysis of White Cast Iron Standards J. I. Shultz, July 16, 1965 pp. 1-62.

CAUTIONS:

1. Determinations made on other than the chill-cast or test surface are not recommended because of the unidirectional solidification structure.
2. The white chill-cast standards are designed for calibration in the analysis of samples prepared in the same manner; samples prepared by other casting techniques or have other than white structure may result in considerable bias.
3. Because the samples exhibit a structure change with respect to columnar grain size, both among standards and from bottom to top of the certified portion of the samples, the surface preparation for x-ray spectroscopic analysis may be critical. (A metallographic polishing technique is recommended).
4. Because of the poor heat conductivity of the white irons, difference in volatility rates for certain elements in emission spectroscopic analysis may occur depending on the location of the burn and the source parameters.
5. Since the indentation in marking the NBS number on the sample is shallow, care will be required in the laboratory to maintain the identity between standards. The user is further cautioned against re-marking the samples by any process, since this may crack the samples.

Supplemental Information

Other Elements: In addition to the certified elements, the following are present at the approximate concentrations listed:

Al	Bi	Pb	Zr
0.001 <sup>a</sup>	0.008 <sup>b</sup>	0.01 <sup>c</sup>	0.02 <sup>a</sup>

<sup>a</sup> Photometric method at NBS.

<sup>b</sup> Average of polarographic method at NBS and photometric method at General Motors Corp.

<sup>c</sup> Average of polarographic and spectrographic methods at NBS.