

**National Bureau of Standards**  
**Certificate of Analyses**  
**Standard Sample 4i**  
**Cast Iron**

ANALYST	C		Mn	P		S			Si	Cu	Ni	Cr	V	Mo	Ti	As	N
	Total	Graphitic	Persulfate-Arsenite	Gravimetric (weighed as $Mg_3P_2O_7$ after removal of arsenic)	Alkali-Molybdate <sup>a</sup>	Gravimetric (direct oxidation and final precipitation after reduction of iron)	Combustion	Evolution (HCl, sp. gr. 1.18, ZnS-iodine <sup>b</sup> theoretical sulfur titer <sup>c</sup> )	Perchloric acid dehydration	$H_2S-CuS-CuO$	Weighted as nickel dimethylglyoxime	$FeSO_4-KMnO_4$ titration	Photometric	$H_2O_2$ -photometric	Distillation-titration		
1.....	3.25	2.62	<sup>d</sup> 0.790	0.131	<sup>e</sup> 0.133	0.054	<sup>f</sup> 0.052	0.056	<sup>g</sup> 1.45	<sup>h</sup> 0.257	0.065	<sup>i</sup> 0.107	<sup>j</sup> 0.012	0.002	<sup>k</sup> 0.026	<sup>l</sup> 0.018	0.007
2.....	<sup>m</sup> 3.25 3.28	2.65	.797	.....	.126	.058	<sup>n</sup> 0.059	.....	<sup>g</sup> 1.48	.250	.063	<sup>o</sup> 0.103	<sup>p</sup> 0.013	.003	<sup>q</sup> 0.029	<sup>r</sup> 0.020	.007
3.....	3.28	2.67	<sup>s</sup> 0.789	.....	.128	.059	.....	<sup>t</sup> 0.057	<sup>u</sup> 1.47	.255	.065	<sup>v</sup> 0.100	<sup>w</sup> 0.012	.003	.026	.....	.....
4.....	3.27	2.65	<sup>s</sup> 0.787	.135	.133	.052	.052	.053	<sup>u</sup> 1.46	<sup>w</sup> 0.256	.060	<sup>v</sup> 0.103	<sup>x</sup> 0.012	.002	.022	<sup>y</sup> 0.016	.005
5.....	3.27	2.66	.779	.124	.130	.054	.....	.051	<sup>u</sup> 1.44	<sup>w</sup> 0.251	.063	<sup>z</sup> 0.103	<sup>p</sup> 0.014	.004	.027	.....	.....
6.....	<sup>m</sup> 3.29 3.27	.....	<sup>s</sup> 0.797	.132	.....	.053	.....	.....	<sup>g</sup> 1.44	<sup>z</sup> 0.25	.061	<sup>o</sup> 0.106	.013	.004	.....	<sup>y</sup> 0.017	.008
7.....	3.23	2.63	<sup>s</sup> 0.797 <sup>z</sup> 0.795	.127	.128	.051	<sup>z</sup> 0.050 0.052	.....	<sup>g</sup> 1.43	<sup>w</sup> 0.25	.058	.100	.....	.005	.....	.....	.007
8.....	3.25	2.63	<sup>s</sup> 0.804	.133	.133	.054	.054	.....	1.44	<sup>z</sup> 0.256	.057	.107	.015	.002	.025	.....	.005
Average...	3.26	2.64	0.793	0.130	0.130	0.054	0.053	0.054	1.45	0.253	0.062	0.104	0.013	0.003	0.026	0.018	0.006
General average...	3.26	2.64	0.793	0.130		0.054			1.45	0.253	0.062	0.104	0.013	0.003	0.026	0.018	0.006

<sup>a</sup> Precipitated at 40° C, washed with a 1-percent solution of  $KNO_3$  and titrated with alkali standardized by the use of acid potassium phthalate and the ratio 23 NaOH:1P.  
<sup>b</sup> Sample annealed by covering with a layer of graphite, and heating for 20 min. at 685° C.  
<sup>c</sup> Value obtained by standardizing the titrating solution by means of sodium oxalate through  $KMnO_4$  and  $Na_2S_2O_8$ , and use of the ratio 21:1S.  
<sup>d</sup> Potentiometric titration.  
<sup>e</sup> Molybdenum-blue photometric method.  
<sup>f</sup> 1-g sample burned in oxygen at 1,425° C and sulfur dioxide absorbed in starch-iodide solution. Iodine liberated from iodide by titration, during the combustion, with standard  $KIO_3$  solution. Titer based on 93 percent of the theoretical factor.  
<sup>g</sup> Double dehydration with intervening filtration.

<sup>h</sup> Diethylthiocarbamate photometric method. See J. Research NBS 47, 380 (1951) RP2265.  
<sup>i</sup> Chromium separated from the bulk of the iron by hydrolytic precipitation with  $NaHCO_3$ , oxidized with persulfate, and titrated potentiometrically with ferrous ammonium sulfate.  
<sup>j</sup> Vanadium separated as in (i), oxidized with  $HNO_3$ , and titrated potentiometrically with ferrous ammonium sulfate.  
<sup>k</sup> Cupferron separation after solution of the sample in diluted HCl (1+2). Vanadium separated by treatment with NaOH.  
<sup>l</sup> Sulfuric acid digestion for 3 hr of a 1-g sample. See J. Research NBS 43, 201 (1949) RP2021.  
<sup>m</sup> Gasometric method.  
<sup>n</sup> Combustion gases absorbed in NaOH- $H_2O_2$ , and excess NaOH titrated with  $H_2SO_4$ .  
<sup>o</sup> Perchloric acid oxidation.

<sup>p</sup>  $FeSO_4-(NH_4)_2S_2O_8-KMnO_4$  method.  
<sup>q</sup> Vanadium separated by  $Na_2CO_3$  fusion.  
<sup>r</sup> Distillation- $H_2S-As_2S_3$ .  
<sup>s</sup> Titrating solution standardized by use of a standard iron or steel.  
<sup>t</sup> Solution in diluted HCl (1+1), and sulfide absorbed in ammoniacal cadmium chloride.  
<sup>u</sup> Sulfuric acid dehydration.  
<sup>v</sup> As in (i), except  $FeSO_4-KMnO_4$  titration  
<sup>w</sup> Finished by electrolysis.  
<sup>x</sup> Photometric method.  
<sup>y</sup> Distillation-titration.  
<sup>z</sup> Diphenylcarbazide photometric method.  
<sup>aa</sup>  $H_2S$  precipitation- $KI-Na_2S_2O_8$  titration.  
<sup>ab</sup> Bismuthate- $FeSO_4-KMnO_4$ .  
<sup>ac</sup> Sulfur gases absorbed in acid  $H_2O_2$  and titrated with sodium borate.

**List of Analysts**

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The iron for the preparation of this standard was furnished by the American Cast Iron Pipe Co.

WASHINGTON, D. C., November 29, 1957.

A. V. ASTIN, Director.