U. S. DEPARTMENT OF COMMERCE

National Bureau of Standards

Certificate of Analyses

OF

STANDARD SAMPLE 152

BASIC OPEN-HEARTH STEEL 0.4% CARBON

(TIN-BEARING)

ANALYST*	C	Mn		P		S			Si	Cu	Ni	Cr	V	Sn	Mo	N
	Direct combustion	Bismuthate ($FeSO_4$-$KMnO_4$)	Persulfate-Arsenite	Gravimetric (weighed as $Mg_2P_2O_7$ after removal of arsenic)	Alkali-Molybdate[a]	Gravimetric (direct oxidation and final precipitation after reduction of iron)	Evolution with HCl (1:1) ZnS-Iodine (theoretical sulfur titer)[l]	Combustion	Sulfuric acid dehydration	H_2S-CuS-CuO	Weighed as nickel dimethylglyoxime	$FeSO_4$-$KMnO_4$ titration				
1	0.464	0.781	0.785	0.019	[c]0.019	0.026	0.026		[d]0.241	0.123	0.062	[e]0.050	[f]0.001	[g]0.036 [h]0.036	[i]0.013	[j]0.004
2	.471	[k].782			[l].020		[m][l].029	[n][l]0.028	[o][d].250	[p].120	[q].066	.049		[r].036		
3	.468	[k].788		[s].019	.019	.028	.028		[o][d].248	.13	.059					
4	.466		.782	.019	.019	.026	.026		[o][d].241	.136	.064	[t].045		[r].039		
5	.462		[u].773		.019	.028			[v].25	[w].127	[x].065	.054		[y].037		
6	.470		.783		[l].022		.027	.026	.248	[p].130	.059	.050		[z].038		
7	.459	.781	.780	[s].020	[c].018	.026	.027	[z][l].029	[v].242	[z][l].127	[q].062	.050		[z2].038		
8	.468	.782	.783	.019	[c].019	.028	.027	[n][l].027	[d].242	.127	.061	.049		[z3].035		
9	.465	[z4].79			.021		[m].025	[l].026	[z5][d].239	[p].121	[x].064	.051		[z].035		
10	.470	.776			[l].021	.029	[m].029		[v][d].243	[p].128	.063	.049		[z6].035		
Averages	**0.466**	**0.783**	**0.781**	**0.019**	**0.020**	**0.027**	**0.027**	**0.027**	**0.244**	**0.127**	**0.062**	**0.050**		**0.036**		
General averages	**0.466**	**0.782**		**0.019**		**0.027**			**0.244**	**0.127**	**0.062**	**0.050**		**0.036**		

[a] 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 23NaOH:1P.

[b] Value obtained by standardizing the titrating solution by means of sodium oxalate through $KMnO_4$ and $Na_2S_2O_3$, and the use of the ratio 2I:1S.

[c] Molybdenum-blue photometric method. See J. Research NBS **26**, 405 (1941) RP1386.

[d] Double dehydration with intervening filtration.

[e] Persulfate oxidation and potentiometric titration with ferrous ammonium sulfate.

[f] Vanadium separated from the bulk of iron in a 10-g sample by selective precipitation with sodium bicarbonate, then oxidized with nitric acid and titrated potentiometrically with ferrous ammonium sulfate.

[g] Sulfide-iodine method. See BS J. Research **8**, 309 (1932) RP415.

[h] 50-g sample dissolved in 1,200 ml of diluted nitric acid (1:4), and acid-sulfides precipitated with H_2S. Sulfides treated with HNO_3-H_2SO_4, tin subsequently distilled with HBr-HCl, precipitated with cupferron and ignited to SnO_2. See reference footnote g, and J. Research NBS **33**, 307 (1944) RP1610. Determination made by R. K. Bell.

[i] $SnCl_2$-KSCN colorimetric method.

[j] Determination made by J. T. Sterling, by the vacuum-fusion method. See BS J. Research **7**, 375 (1931) RP346.

[k] Titration with sodium arsenite.

[l] Titrating solution standardized by use of a standard steel.

[m] Absorbed in ammoniacal cadmium chloride solution.

[n] Iodate-titration.

[o] Nitric-sulfuric acid dehydration.

[p] Finished by electrolysis.

[q] Dimethylglyoxime colorimetric method.

[r] Solution of the steel in diluted HNO_3, tin precipitated as the sulfide, reduced with iron and titrated with KIO_3 standardized with high-purity tin.

[s] Weighed as ammonium phosphomolybdate.

[t] Diphenylcarbazide-colorimetric method.

[u] Perchloric acid method. See Iron Age **142**, No. 15, 255 (1938).

[v] Perchloric acid dehydration.

[w] Copper precipitated as cyanate, precipitate ignited and copper titrated with KCN.

[x] Glyoxime-cyanide titration method.

[y] Solution in diluted HNO_3 and tin precipitated with H_2S. Sulfides ignited to oxides, impurities removed, and tin again precipitated as the sulfide, ignited, and weighed as SnO_2.

[z] Sulfur gases absorbed in NaOH-H_2O_2 solution. Titration with H_2SO_4.

[z1] H_2S-α-benzoinoxime-CuO method.

[z2] As in (r), but tin reduced with test lead and titrated with iodine standardized with a tin-free steel plus a known amount of tin, treated as in the procedure.

[z3] As in (r) but tin reduced with nickel and titrated with iodine using the theoretical titer.

[z4] Potentiometric titration with mercurous nitrate.

[z5] HCl dehydration.

[z6] 10-g sample dissolved in 75 ml of $HClO_4$ (70%), plus a few crystals of $KMnO_4$. Solution diluted and tin precipitated as sulfide, subsequently reduced with aluminum (plus antimony) and titrated with iodate, using the theoretical factor.

*LIST OF ANALYSTS

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The steel for the preparation of this standard was furnished by the Weirton Steel Co.

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