UNITED STATES DEPARTMENT OF COMMERCE
WASHINGTON

O.D.S.

National Bureau of Standards
Certificate of Analyses
Standard Sample 20 F
Acid Open-Hearth Steel, 0.4% Carbon

ANALYST	C	Mn		P		S			Si	Cu	Ni	Cr	V	Mo	N	Sn
	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 precipitation after reduction of iron)	Combustion Iodate titration [b]	Evolution with HCl (1–1) ZnS-Iodine (theoretical sulfur titer) [c]	Sulfuric acid dehydration	H_2S–CuS–CuO	Weighed as nickel dimethylglyoxime	$FeSO_4$–$KMnO_4$ titration		Colorimetric	Distillation-titration	
1	0.380		[d]0.757	0.026	[e]0.026	0.034	0.034	0.032	[f]0.296	[g]0.238	0.243	[h]0.099	[i]0.007	0.058	[j]0.004	[k]0.021
2	.383	[l].752			.028		.036		[m].308	[n].244	[o].248	[p].098	[q].008	.058		
3	.378		[r].750		.028		[r].034		[m].286	[n].231	.243	.095	.005	.057	.005	
4	{.386 [s].387}		[r].752		{[r].027 [t].026}		[r].035		[m].296	[u].248	.253	[r,v].095	[q].009	.065		
5	{[s].38 .375}		.75	.029	.030	.033	.034		.293	[n].23	.23	.099	.006	[w].055	[x].005	
6	.375		[r].77		.029		.033		[m,f].310	[n].239	.246	.097	[y].005	.060	.006	
7	.378		[r].749	.027	[r].027	.034		.032	.304	[n].240	[z].238	.095	[z1,r].008	.056		
Average	0.380	0.752	0.755	0.027	0.028	0.034	0.034	0.032	0.299	0.238	0.243	0.097	0.007	0.058	0.005	
General average	0.380	0.754		0.028		0.034			0.299	0.238	0.243	0.097	0.007	0.058	0.005	

[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] 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.

[c] 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.

[d] Potentiometric titration.

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

[f] Double dehydration with intervening filtration.

[g] Diethyldithiocarbamate photometric method. See J. Research NBS **47**, 380 (1951) RP2265.

[h] Chromium separated from the bulk of the iron in a 10–g sample by hydrolytic precipitation with $NaHCO_3$, oxidized with persulfate, and titrated potentiometrically with ferrous ammonium sulfate.

[i] Vanadium separated as in [h], oxidized with HNO_3, and titrated potentiometrically with ferrous ammonium sulfate.

[j] Sulfuric acid digestion for 3 hours of a 1–g sample. See J. Research NBS **43**, 201 (1949) RP2021.

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

[l] Potentiometric titration with $HgNO_3$.

[m] Perchloric acid dehydration.

[n] Finished by electrolysis.

[o] Dimethylglyoxime precipitate titrated with KCN.

[p] Persulfate oxidation, potentiometric titration with ferrous ammonium sulfate.

[q] Nitric acid oxidation, potentiometric titration with ferrous ammonium sulfate.

[r] Titrating solution standardized with a standard steel.

[s] Differential gaseometric method.

[t] Colorimetric method.

[u] Iron precipitated with an excess of NH_4OH in a HNO_3-persulfate solution. Copper determined by electrolysis in an aliquot portion of the filtrate.

[v] Perchloric acid oxidation, titration with $FeSO_4$–$K_2Cr_2O_7$ diphenylamine sulfonate indicator.

[w] H_2S–MoS_3–MoO_3.

[x] Finished photometrically with Nessler's reagent.

[y] $NaHCO_3$ hydrolysis followed by mercury cathode. Vanadium titrated with $FeSO_4$ using diphenylamine sulfonate indicator.

[z] Dimethylglyoxime precipitate ignited to NiO.

[z1] Vanadium separated with cupferron and determined by the $FeSO_4$–$(NH_4)_2S_2O_8$–$KMnO_4$ method.

List of Analysts

1. Ferrous Laboratory, National Bureau of Standards. J. I. Shultz in charge. Analysis by R. E. McIntyre, E. June Maienthal, and Lorna J. Tregoning.
2. J. A. Wiley, Midvale-Heppenstall Co., Nicetown, Philadelphia, Pa.
3. W. A. Richardson, Kaiser Steel Corp., Fontana Works, Fontana, Calif.
4. C. H. Flickinger, Republic Steel Corp., Cleveland, Ohio.
5. C. L. Abbott, Bethlehem Steel Co., Lackawanna Plant, Lackawanna, N. Y.
6. S. Partington, The Detroit Testing Laboratory, Inc., Detroit, Mich.
7. J. C. Nagy, Charles C. Kawin Co., Buffalo, N. Y.

The steel for the preparation of this standard was furnished by the Midvale-Heppenstall Company, Nicetown, Philadelphia, Pa.

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A. V. ASTIN, *Director.*

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