UNITED STATES DEPARTMENT OF COMMERCE
WASHINGTON

National Bureau of Standards
Certificate of Analyses

Standard Sample 11G
Basic Open-Hearth Steel, 0.2% Carbon

ANALYST	C	Mn	P		S			Si	Cu	Ni	Cr	V	Mo	Sn	N
	Direct combustion	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	Evolution with HCl (1–1) ZnS-Iodine (theoretical sulfur titer) [b]	Sulfuric acid dehydration	H_2S–CuS–CuO	Weighed as nickel dimethylglyoxime	$FeSO_4$–$KMnO_4$ titration		Colorimetric		Distillation-titration
1	0.188	[c] 0.517	0.008	[d] 0.007	0.024	[e] 0.025	0.026	[f] 0.204	[g] 0.048	0.019	[h] 0.015	[i] 0.001	0.005	[j] 0.004	[k] 0.006
2	.194	{[l] .520 / [l] .521}	.008	{[m] .008 / .009}	.027	[n] .025	.026	{[o] .206 / [p,f] .202}	[q] .048	[r] .021	[s] .015	[t] .001	.005	----	[k] .005
3	.195	[n] .508	----	[n] .009	----	[n] .025	----	[p] .205	[u] .040	[r] .020	[v] .016	----	.007	----	----
4	[w] .193	[x] .511	----	[d] .009	----	.025	.024	[f] .200	[q] .047	[r] .021	[y] .013	----	.007	----	----
5	.195	[n] .509	----	.010	----	.029	.028	.202	[z] .051	[r] .021	[s] .014	.001	.005	----	----
	.187	[z1] .508	----	.008	----	.027	----	[p,f] .202	[z] .040	.022	[s] .015	[z2] .002	.004	[z3] .003	[z4] .006
7	.188	[n] .514	.009	.009	.028	[n] .026	.028	[f] .206	{.045 / [q] .043}	[r] .020	.014	[z5,n] .002	.004	----	[z4] .006
8	.185	[n] .513	----	[d] .008	----	.027	----	[p] .202	[z6] .050	.016	.019	[z7] .002	.006	----	----
Average	0.191	0.513	0.008	0.009	0.026	0.026	0.026	0.203	0.046	0.020	0.015	0.001	0.005	0.004	0.006
General average	0.191	0.513	0.008		0.026			0.203	0.046	0.020	0.015	0.001	0.005	0.004	0.006

[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] Potentiometric titration.

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

[e] 1-g sample burned in oxygen at 1425° 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.

[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 sample by $NaHCO_3$ hydrolysis, 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] Sulfide-iodine method. See BS J. Research **8**, 309 (1932) RP415.

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

[l] Persulfate-photometric method.

[m] Molybdenum-blue photometric method. See Anal. Chem. **23**, 1496 (1951).

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

[o] Silico-molybdate colorimetric method. See Anal. Chem. **21**, 589 (1949).

[p] Perchloric acid dehydration.

[q] Diethyldithiocarbamate photometric method.

[r] Dimethylglyoxime photometric method.

[s] Diphenylcarbazide photometric method.

[t] Vanadium precipitated with cupferron and determined by the phosphotungstovanadate photometric 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] Gaseometric measurement.

[x] Periodate photometric method.

[y] Persulfate oxidation, potentiometric titration with $FeSO_4$.

[z] Finished by electrolysis.

[z1] Bismuthate method.

[z2] $NaHCO_3$ hydrolysis followed by mercury cathode. Vanadium oxidized by the $KMnO_4$-nitrite-urea method and titrated with $FeSO_4$ using diphenylbenzidine sulfonate indicator.

[z3] Stanreduce-iodate titration method.

[z4] Finished photometrically with Nessler's reagent.

[z5] As in (i), but titrated with $FeSO_4$–$K_2Cr_2O_7$.

[z6] Copper-ammonia complex photometric method.

[z7] Nitric acid oxidation, potentiometric titration with ferrous ammonium sulfate.

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The steel for the preparation of this standard was furnished by the Inland Steel Company, East Chicago, Ind.

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A. V. ASTIN, *Director*.

Proof

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