U.S. DEPARTMENT OF COMMERCE
WASHINGTON 25, D.C.

National Bureau of Standards Certificate of Analyses

Standard Sample 55 E
Open-Hearth Iron

ANALYST	C	Mn	P		S			Si	Cu	Ni	Cr	V	Mo	Co	Sn	Al	As	N
			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 (HCl sp. gr. 1.18–ZnS-iodine-theoretical sulfur titer) [b]	Perchloric acid dehydration		Weighed as nickel dimethylglyoxime	$FeSO_4$–$KMnO_4$ titration		Photometric	Colorimetric Nitroso-R		Total		Distillation-Photometric
1	[c]0.010$_8$	[d]0.035	0.002	[e]0.002	0.011	[f]0.010	0.012	[g]0.001	[h]0.066	0.038	[i]0.005	<[i]0.001	0.011	0.007	[k]0.007	[l]0.001	[m]0.006	[n]0.004
2	[c].010$_2$	[o].037		[p].002		.011		<[q].001	[r].063	{[s].040 / .039}	[t].004	<[j].001	.011	.008		[u].001	{[q].007 / [v].006}	.005
3	[c].011$_8$	[w].035		{[q].001 / .002}	.014	.012		<[q].001	[x].067	[s].037	[t].005	<[v].001	.012	[z].006		[a′].002	[q].008	[b′].004
4	[c′].010$_7$	[w].036		.003		.011		<.001	[r].066	[s].040	[t].007	<[d′].001	.012	.006	[e′].006	[a′].002	[q].008	.004
5	[c].011$_1$	[f′].035		.002		[g′].012			[f′].063	[f′].035	[f′].006	[f′].002	[f′].009	[f′].005	[f′].008			
	[h′].012$_0$	[i′,j′].039		.004		.012		[k′].002		[s].033	[l′].009		.012			[a′].001		.005
	[h′].012$_7$	[i′,j′].030	.004	.004	.010	[j′].011		<.001	[m′].064	[s].038	[t].005	<[n′].001	.011	.008		[o′].001	[p′].006	[b′].004
8	[c].010$_6$	[w].036	.004	[e].004	.011	[q′].011		.001	[r].065	[s].039	[t].009	[r′].001	.012	.006		[s′].003	[q].008	.005
Average	0.011$_2$	0.035	0.003	0.003	0.012	0.011	0.012	0.001	0.065	0.038	0.006	<0.001	0.011	0.007	0.007	0.002	0.007	0.004
General average	0.011$_2$	0.035	0.003		0.011			0.001	0.065	0.038	0.006	<0.001	0.011	0.007	0.007	0.002	0.007	0.004

[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 23 NaOH:1P.
[b] Value obtained by standardizing the titrating solution by means of sodium oxalate through $KMnO_4$ and $Na_2S_2O_3$, and use of the ratio 2I:1S.
[c] Conductometric method.
[d] 10-g samples extracted with ether. Persulfate-arsenite potentiometric titration method.
[e] Molybdenum-blue photometric method. See J. Research NBS **26**, 405 (1941) RP1386.
[f] 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.
[g] Double H_2SO_4 dehydration with intervening filtration.
[h] Diethyldithiocarbamate photometric method. See J. Research NBS **47**, 380 (1951) RP2265.
[i] 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.
[j] Vanadium separated as in (i), oxidized with HNO_3, and titrated potentiometrically with ferrous ammonium sulfate.
[k] Sulfide-iodine method. See NBS J. Research **8**, 309 (1932) RP415.
[l] Mercury cathode-cupferron-aluminon photometric method. See J. Research NBS **64A**, No. 3, 235 (1960).
[m] Distillation-molybdenum-blue photometric method. See J. Research NBS **24**, 7 (1940) RP1267.
[n] Sulfuric acid digestion for 4 hr of 0.5-g sample. See J. Research NBS **43**, 201 (1949) RP2021.
[o] Persulfate photometric method.
[p] Ammonium phosphomolybdate extracted with isobutyl alcohol, reduced to molybdenum-blue and phosphorus determined photometrically.
[q] Molybdenum-blue photometric method.
[r] Diethyldithiocarbamate photometric method.
[s] Dimethylglyoxime photometric method.
[t] Diphenylcarbazide photometric method.
[u] Ether-cupferron-Eriochrome Cyanine-R photometric method.
[v] Distillation-H_2S-As_2S_3.
[w] Periodate photometric method.
[x] Neocuproine photometric method.
[y] Phosphotungstovanadate photometric method.
[z] Tetraphenylarsonium chloride-complex colorimetric method.
[a′] Aluminon photometric method.
[b′] Distillation-titration.
[c′] Gasometric method.
[d′] $FeSO_4$–$(NH_4)_2S_2O_8$–$KMnO_4$ method.
[e′] Stanreduce-iodate titration method.
[f′] Spectrochemical determination.
[g′] Combustion gases absorbed in neutral H_2O_2 solution and titrated with NaOH.
[h′] Direct combustion.
[i′] Persulfate-arsenite method.
[j′] Titrating solution standardized by use of a standard steel.
[k′] Sulfuric acid dehydration.
[l′] Perchloric acid photometric method.
[m′] Copper-ammonia complex photometric method.
[n′] H_2O_2 photometric method.
[o′] Aluminum precipitated as phosphate after reduction of the iron. Precipitate fused with Na_2CO_3, aluminum reprecipitated, ignited, and weighed as $AlPO_4$.
[p′] Distillation-titration with standard $KBrO_3$.
[q′] Combustion gases absorbed in neutral H_2O_2, solution titrated with sodium borate using methyl red indicator.
[r′] Vanadium separated with cupferron and determined by phosphotungstovanadate photometric method.
[s′] Eriochrome Cyanine-R photometric method.

List of Analysts

1. Ferrous Laboratory, National Bureau of Standards. J. I. Shultz, in charge. Analysis by T. W. Freeman, E. J. Maienthal, and R. J. Bowen.
2. Arba Thomas, Armco Steel Corp., Research Center, Middletown, Ohio.
3. H. N. Fry and R. A. Lannoye, Union Carbide Metals Co., Division of Union Carbide Corp., Niagara Falls, N.Y.
   C. G. Hummon, W. W. Weber, H. L. Smith, and F. E. Moore, Sheffield Division, Armco Steel Corp., Kansas City, Mo.
5. K. H. Storks, E. K. Jaycox, and F. W. Ryan, Bell Telephone Laboratories, Murray Hill, N.J.
6. W. H. Weigel, United States Steel Corp., Clairton Works, Clairton, Pa.
7. D. G. Wilson, United States Steel Corp., Columbia Geneva Division, Geneva Works, Provo, Utah.
8. R. W. Bley, Inland Steel Co., Indiana Harbor Works, East Chicago, Ind.

The iron for the preparation of this standard was furnished by the Armco Steel Corporation.

WASHINGTON, D.C., February 2, 1961

U.S. GOVERNMENT PRINTING OFFICE 16—76378-1

A. V. ASTIN, *Director.*