UNITED STATES DEPARTMENT OF COMMERCE
WASHINGTON 25, D.C.

National Bureau of Standards Certificate of Analyses

Standard Sample 170A
Basic Open-Hearth Steel, 0.05% Carbon

ANALYST	C	Mn	P		S		Si	Cu	Ni	Cr	V	Mo	Ti	Zr	Al	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	Perchloric acid dehydration		Weighed as nickel dimethylglyoxime	$FeSO_4$-$KMnO_4$ titration		Colorimetric	H_2O_2-photometric		Total		Distillation-Photometric
1	0.051	[b]0.329	0.004	[c]0.005	0.020	[d]0.020	[e]0.036	[f]0.060	0.025	[g]0.014	[h]0.013	0.006	0.278 / [i]0.282	[j]0.038	[k]0.042	[l]0.006	[m]0.005
2	.053	[n].322 / [o].321	.005	[o].005	.020	[p].020	[e,q].040	[r].061	[o].031	[s].014	[t].005	.004	.281	[j].042 / [o].041	[u].050		[m].005
3	[v].055 / .056	[n].327		[o].005			[o].022	[e].035	[w].063 / [x].062	[o].022 / .025	[y].019	[z].009	.005	.291	[a']. 035	[b']. 036		
4	.047	.325	.004	.005	.021	.021	[c'].034 / .036	[d'].059	.024 / [o].026	[s].015	[e'].012	.005	[i].283 / .285	[j].036	[u].049	[l].007	[m].006
5	.049	.331	[f'].005	.005	.021	.022	.034	[g'].054	.026	.013	[h'].007	.006	.267	[j].042	[k].058		.002
6	[i'].059	.324		.007		[j'].020	[o'].029	[k'].054	.027	.011	[l'].006	.007	.290	.034	[k].043		
7	.050	[m'].320 / [n].322	.004	[n].005	.023	[n].023	[e',e].043	[f].058	.025	.013 / [s].012	[n'].012	.004	[o'].280	[j].035	[p'].042		[q'].005
8	[r'].048 / .051	[n].327		.007	.020	.021	[e',e].038	[s'].060	.025	.015	[l'].010	.003	.272	[j].031			[q'].005
Average	0.052	0.325	0.004	0.006	0.021	0.021	0.036	0.059	0.026	0.014	0.009	0.005	0.281	0.037	0.046	0.006	0.005
General Average	0.052	0.325	0.005		0.021		0.036	0.059	0.026	0.014	0.009	0.005	0.281	0.037	0.046	0.006	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 23 NaOH:1P.

[b] Potentiometric titration.

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

[d] 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. Titer solution based on 93 percent of the theoretical factor.

[e] Double dehydration with intervening filtration.

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

[g] Chromium separated from the bulk of iron in a 10-g sample by hydrolytic precipitation with $NaHCO_3$. Persulfate oxidation and potentiometric titration with ferrous ammonium sulfate.

[h] Vanadium separated as in (g). Nitric acid oxidation and potentiometric titration with ferrous ammonium sulfate.

[i] 5-g sample dissolved in dilute H_2SO_4 and titanium precipitated with cupferron. Ignited precipitate treated with $HClO_4$-HF, reignited and fused in $Na_2S_2O_7$. Melt dissolved in tartaric-sulfuric acid solution, and the H_2S group removed. Iron removed as sulfide in ammoniacal-tartrate solution. Filtrate acidified and titanium precipitated with cupferron. Ignited precipitate corrected for Al_2O_3 and ZrO_2.

[j] Cupferron-H_2O_2-phosphate method. ASTM method, E30–56.

[k] $NaHCO_3$-NaOH-Al_2O_3 method. See ASTM method, E30–56.

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

[m] Sulfuric acid digestion for 4 hr of a 0.5-g sample. See J. Research NBS **43**, 201 (1949) RP 2021.

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

[o] Photometric method.

[p] Combustion gases absorbed in neutral H_2O_2, solution titrated with sodium borate.

[q] Same value obtained by silicomolybdate photometric method.

[r] Diethyldithiocarbamate photometric method.

[s] Diphenylcarbazide photometric method.

[t] Vanadium separated with cupferron and determined by phosphotungstovanadate photometric method.

[u] Eriochrome Cyanine-R photometric method.

[v] Gasometric method.

[w] Copper-ammonia-complex photometric method.

[x] Excess of NH_4OH added to a HNO_3-persulfate solution of a 10-g sample. Copper determined by electrolysis in an aliquot portion of the filtrate.

[y] Perchloric acid oxidation, titration with $FeSO_4$-$K_2Cr_2O_7$ using diphenylamine sulfonate indicator.

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

[a'] Zirconium precipitated with para-hydroxyphenyl arsonic acid and weighed as ZrO_2.

[b'] Sodium thiosulfate-sodium phosphate method.

[c'] Sulfuric acid dehydration.

[d'] Neocuproine photometric method.

[e'] Ether-cupferron separation on a 10-g sample. Vanadium titrated by the $FeSO_4$-$(NH_4)_2S_2O_8$-$KMnO_4$ method.

[f'] Weighed as ammonium phosphomolybdate.

[g'] $Na_2S_2O_3$- electrolysis.

[h'] Vanadium separated as in (h), and determined by $FeSO_4$-$(NH_4)_2S_2O_8$-$KMnO_4$ method.

[i'] Combustion-titration method.

[j'] Combustion gases absorbed in neutral H_2O_2 solution and titrated with NaOH using methyl red indicator.

[k'] H_2S-CuS-electrolytic method.

[l'] $FeSO_4$-$(NH_4)_2S_2O_8$-$KMnO_4$ method.

[m'] Bismuthate method.

[n'] $NaHCO_3$-mercury cathode-$FeSO_4$-$K_2Cr_2O_7$ method.

[o'] Titanium precipitated with phenylhydrazine and weighed as TiO_2.

[p'] Aluminon photometric method.

[q'] Distillation-titration.

[r'] Carbon weighed as $BaCO_3$.

[s'] H_2S precipitation-KI-$Na_2S_2O_3$ titration.

List of Analysts

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