UNITED STATES DEPARTMENT OF COMMERCE
WASHINGTON

National Bureau of Standards
Certificate of Analyses

Standard Sample 33 d
Nickel Steel

ANALYST	C	Mn		P		S			Si	Cu	Ni	Cr	V	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 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	Distillation-titration
1	0.172		[c]0.543	0.006	[d]0.005	0.010	[e]0.011	0.010	[f]0.259	[g]0.122	3.56	[h]0.148	[i]0.002	0.248	[j]0.011
2	.170	.534	.534		.006	.009	[k].011		[l].256	[m].123	{[n]3.58, 3.61}	{.145, [o].143}	[p].001	{[q].246, .242}	
3	.178		[k].538		.006		[k].010	[r].009	[l].250	[o].126	[s]3.59	.139	[u].003	.244	
4	.167	.53	[k].535	[v].005	{.005, [d].006}	.010	[e].011		[l].245	[m].122	{3.56, [w]3.57}	[x].142	[y].001	.249	
5	.180		.547		.006		[k].014		.253	[z].123	3.60	[o].140	.002	.244	
Averages	0.173	0.532	0.539	0.006	0.006	0.010	0.011	0.010	0.253	0.123	3.58	0.143	0.002	0.246	
General average	0.173	0.537		0.006		0.010			0.253	0.123	3.58	0.143	0.002	0.246	

[a] Precipitated at 40° C, washed with a 1-percent solution of KNO_3, and titrated with alkali standardized by the use of National Bureau of Standards 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] Potentiometric titration.

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

[e] 1-g sample burned in oxygen at 1,425° C, and sulfur dioxide absorbed in starch-iodine 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] H_2SO_4 dehydration. Double evaporation 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 $NaHCO_3$ 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] 0.5-g sample dissolved in dilute H_2SO_4 (1:2), and solution evaporated to fumes of sulfuric acid. See J. Research NBS 43, 201 (1949) RP2021.

[k] Titrating solution standardized with a standard steel.

[l] Double dehydration.

[m] Sulfide precipitation, KI–$Na_2S_2O_3$ titration.

[n] Dimethylglyoxime precipitate titrated with cyanide.

[o] Diphenylcarbazide photometric method.

[p] Vanadium precipitated with cupferron from a 10-g sample and determined by the H_2O_2-photometric method.

[q] Alpha-benzoinoxime method. See BS J. Research 9, 1 (1932) RP453.

[r] Absorbed in ammoniacal cadmium chloride.

[s] CuS-electrolytic method.

[t] Ether separation of iron on a 1-g sample. Dimethylglyoxime precipitate titrated with cyanide.

[u] Vanadium separated from the bulk of the iron in a 5.0-g sample by extraction with ether, oxidized with $HClO_4$ and titrated by the $FeSO_4$-$KMnO_4$ procedure after addition of H_3PO_4 and K_2HPO_4, using ortho-phenanthroline ferrous perchlorate as an indicator.

[v] Weighed as ammonium phosphomolybdate.

[w] Polarographic method.

[x] As in (h), but titrated with $FeSO_4$-$KMnO_4$.

[y] Bicarbonate hydrolysis on a 30-g sample. Vanadium titrated by the $(NH_4)_2S_2O_8$-$KMnO_4$ method.

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