UNITED STATES DEPARTMENT OF COMMERCE

National Bureau of Standards Certificate of Analyses

Standard Sample 160A

19 Chromium—14 Nickel—3 Molybdenum Steel

ANALYST	C	Mn	P	S		Si	Cu	Ni	Cr	V	Mo	Co	Sn	Pb	N
	Direct combustion		Photometric	Gravimetric (direct oxidation and final precipitation after reduction of iron)	Combustion Iodate titration	Perchloric acid dehydration	Photometric	Weighed as nickel dimethylglyoxime	$FeSO_4$–$KMnO_4$ titration	HNO_3 oxidation, potentiometric titration	Photometric			Photometric	Distillation-titration
1	0.062	[a,b] 1.61	[o] 0.027, [d] 0.029	0.016	[e] 0.017	[f] 0.608	[g] 0.178	14.11	[h] 18.73	0.048	[i] 2.87	[j] 0.072	[k] 0.014	[l] 0.001	[m] 0.051
2	.061	[n] 1.64	[o] .029, [d] .028		.016	[f] .607	[p] .19	14.10	[q] 18.73	.047	[r] 2.84	[s] .068, [t] .070	[k] .013		[m] .054
3	.061	[u,b] 1.62	[o] .025		.018	[f] .612	[v] .16	14.09	[h] 18.75	.058	[r] 2.88			[l] .001	
4	.069	[w] 1.61	[x] .025	.017	.016	.595	[y] .174	[z] 14.18	18.73	.054	[r] 2.77	[a'] .068	[k] .011	[l] .002	.050
5	[b'] .062	[w] 1.67	[d] .026		.015	[e',f] .619	[y] .182	14.12	[h] 18.73		[r] 2.86	[j] .072			
6	[d'] .061	[e'] 1.61	[x] .026	.013	[f'] .014	.596	[y] .169	[z] 14.20	[g'] 18.79	.051	[r] 2.79	[j] .072	[k] .017		.052
7	[h'] .059	[i'] 1.61	[j'] .025	[k'] .014		[f] .601	[p] .175	[l'] 14.09	18.70	[m'] .045	[n'] 2.84, [r] 2.81	[j] .072	[k] .013		.052
	.063	[r] 1.64	[x] .027		.016	[o'] .62	[p'] .17	[q'] 14.15	18.75	[r'] .050	[r] 2.79	[s'] .075	[t'] .010	[l] .001	[u'] .049
9	.062	[v'] 1.61	[d] .027		.015	.59	[w'] .170	14.14, [z] 14.12	[x'] 18.72	.056	[i] 2.85, [r] 2.81				.050
Average	0.062	1.62	0.027	0.015	0.016	0.605	0.174	14.13	18.74	0.051	2.83	0.071	0.013	0.001	0.051
General average	0.062	1.62	0.027	0.016		0.605	0.174	14.13	18.74	0.051	2.83	0.071	0.013	0.001	0.051

[a] Chromium separated by hydrolytic precipitation with $NaHCO_3$. Persulfate oxidation-arsenite titration.
[b] Potentiometric titration.
[c] Molybdate-$Mg_2P_2O_7$.
[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-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] Persulfate oxidation and potentiometric titration with ferrous ammonium sulfate.
[i] α-benzoinoxime method. See BS J. Research **9**, 1 (1932) RP453.
[j] Nitroso-R photometric method.
[k] Sulfide-iodine method. See BS J. Research **8**, 309 (1932) RP415.
[l] Dithizone photometric method.
[m] Sulfuric acid digestion for 3 hr of a 0.5 g sample. See J. Research NBS **43**, 201 (1949) RP2021.
[n] ZnO-Bismuthate-$FeSO_4$-$KMnO_4$.
[o] Molybdate-alkali titration method.
[p] 2,2′ biquinoline colorimetric method.
[q] Persulfate oxidation, potentiometric titration with $FeSO_4$–$K_2Cr_2O_7$.
[r] Photometric method.
[s] α nitroso-β naphthol method. Weighed as Co_3O_4.
[t] Tetraphenylarsonium chloride-cobalt complex colorimetric method.
[u] Bismuthate-$HgNO_3$ titration.
[v] CuS precipitated with $Na_2S_2O_3$, and the determination completed electrolytically.
[w] KIO_3 photometric method.
[x] Molybdenum-blue photometric method.
[y] Diethyldithiocarbamate photometric method.
[z] Dimethylglyoxime precipitate titrated with cyanide.
[a'] ZnO-HCl photometric method.
[b'] Gasometric method.
[c'] Sulfuric acid dehydration.
[d'] Conductometric method.
[e'] ZnO-persulfate-arsenite method.
[f'] Combustion gases absorbed in NaOH–H_2O_2. Solution titrated with H_2SO_4.
[g'] Perchloric acid oxidation.
[h'] Purified CO_2 frozen in liquid oxygen trap. Oxygen pumped off and CO_2 vaporized into known volume and the pressure measured.
[i'] ZnO separation-persulfate oxidation, titration with $FeSO_4$–$K_2Cr_2O_7$ using sodium diphenylamine sulfonate indicator. See British Standard 1121, part 16 (1948).
[j'] Ammonium phosphomolybdate-lead molybdate method.
[k'] Iron reduced with hydroxylamine hydrochloride before precipitation of $BaSO_4$.
[l'] Dimethylglyoxime precipitate titrated with ethylenediamine tetra-acetate using murexide indicator.
[m'] Vanadium separated by electrolysis with a mercury cathode, oxidized by $KMnO_4$-nitrite-sulfamate, and titrated with ferrous ammonium sulfate.
[n'] H_2S–MoS_3–$PbMoO_4$.
[o'] Fusion with Na_2O–Na_2CO_3 and HCl dehydration.
[p'] Neo-cuproine photometric method.
[q'] Dimethylglyoxime photometric method.
[r'] Vanadium separated as in m′, reduced with SO_2 and titrated with $KMnO_4$.
[s'] Thiocyanate-photometric method.
[t'] Tin distilled as the bromide and titrated with iodate.
[u'] Distillation-photometric with Nessler's reagent.
[v'] Chromium volatilized as CrO_2Cl_2. Titration with arsenite-nitrite solution.
[w'] CuCNS precipitation, $CuCl_2$ photometric method.
[x'] Persulfate oxidation, titration with $FeSO_4$–$K_2Cr_2O_7$, ortho-phenanthroline indicator.

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The steel for the preparation of this standard was furnished by The Carpenter Steel Company.

WASHINGTON, D.C., March 2, 1959

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U.S. GOVERNMENT PRINTING OFFICE 801417