U. S. Department of Commerce

National Bureau of Standards

Certificate of Analyses

Standard Sample 160

19 Chromium—9 Nickel—3 Molybdenum Steel

ANALYST	C	Mn	P		S		Si	Cu	Ni	Cr	V	Mo		Co	N	
	Direct combustion		Gravimetric (weighed as $Mg_2P_2O_7$ after removal of arsenic)	Alkali-molybdate[a]	Gravimetric (direct oxidation and precipitation after reduction of iron)	Combustion	Perchloric acid dehydration	COPPER H_2S-CuS-CuO	Weighed as nickel dimethylglyoxime	$FeSO_4$-$KMnO_4$ titration	VANADIUM	Gravimetric	Colorimetric	COBALT Zinc oxide-α-nitroso-β-naphthol	NITROGEN Solution—Distillation	
1	0.043	[b].69	0.012	[c]0.012	0.008	[d]0.010	[e]1.14	0.050	8.94	[f]19.12	[g]0.035	[h]2.95	2.93	0.064	[i]0.029	
2	.047	[i].69		.011		[d].008	1.13	[k].06	[l]8.89	[f]19.12		[m]2.97	2.94			
3	.040	[n].70	[o].010	.013	.010		1.15	[p].050	8.92	19.11		[m]2.94			[q].030	
4	.045	[r].67		[c].011	.012	[s].011	1.14	[t].053	[l]8.90	[u]19.13	[v].041		2.98	[w].054	[q].025	
5	.044	[x].66		.015		[s].009	1.12		[y]8.89	[u]19.09			3.00			
6	.047	[x].66		.013		[s].012	1.11	[z].057	[y]8.90	[u]19.16		[m]2.92				
7	.043	[z1].66		[c].012		[d].011	1.10	[z2].047	[l]8.88	19.12		[b]2.93	2.91			
8	.045			.012		[d].012	[e]1.13	.055	8.88	[f]19.13		[h]2.96				
Average	0.044	0.68	0.011	0.012	0.010	0.010	1.13	0.053	8.91	19.12	0.038	2.95	2.95	0.059	0.028	
General average	0.044	0.68	0.012		0.010		1.13	0.053	8.91	19.12	0.038	2.95		0.059	0.028	

[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] Bicarbonate-bismuthate-$FeSO_4$-$KMnO_4$ titration method.

[c] Molybdenum-blue photometric method.

[d] 1-g sample burned in oxygen at 1425° C, and sulfur dioxide absorbed in starch-iodine solution. Iodine liberated from iodide by titration, during the combustion, with standard KIO_3 solution based on 93 percent of the theoretical factor.

[e] Double dehydration with intervening filtration.

[f] Persulfate oxidation and potentiometric titration with ferrous ammonium sulfate standardized with potassium dichromate.

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

[h] α-Benzoinoxime method. See BS J. Research 9, 1 (1932) RP453.

[i] Semimicro-distillation-titration method. 0.5-g sample fumed 4 hours with H_2SO_4.

[j] Bismuthate-$HgNO_3$ potentiometric titration method.

[k] $Na_2S_2O_3$ precipitation-electrolytic method.

[l] Dimethylglyoxime precipitation-cyanide titration.

[m] H_2S-MoO_3.

[n] CrO_2Cl_2-bismuthate method.

[o] Weighed as ammonium phosphomolybdate.

[p] KI-$Na_2S_2O_3$ titration method.

[q] Allen method. Solution in diluted HCl (1–1).

[r] Periodate photometric method.

[s] Burned with tin, and iodate solution standardized on standard steels.

[t] Diethyldithiocarbamate photometric method.

[u] Perchloric acid oxidation.

[v] Differential titration with $KMnO_4$, using o-phenanthroline indicator.

[w] Cobalt chloride-photometric method.

[x] ZnO-persulfate-arsenite method.

[y] Dimethylglyoxime-nickel oxide method.

[z] H_2S-alpha benzoinoxime-CuO method.

[z1] Chromium volatilized as CrO_2Cl_2. Manganese oxidized with persulfate and titrated with arsenite-nitrite solution.

[z2] CuCNS-cupric chloride photometric method.

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The steel for the preparation of this standard was furnished by the Alloy Casting Institute.

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Washington, D. C., March 2, 1949.

U. S. GOVERNMENT PRINTING OFFICE 841891