U. S. DEPARTMENT OF COMMERCE

National Bureau of Standards

Certificate of Analyses

OF

STANDARD SAMPLE 153

COBALT—MOLYBDENUM—TUNGSTEN STEEL

ANALYST *	C	Mn	P	S		Si			Cr	V	Mo		W		Co	
	Direct/combustion	Persulfate-Arsenite	Alkali-Molybdate	Gravimetric (direct oxidation and precipitation after reduction of iron)	Combustion	Nitric-hydrochloric acid dehydration	COPPER H_2S-CuS-CuO	NICKEL Weighed as nickel dimethylglyoxime	$FeSO_4$-$KMnO_4$ titration	HNO_3 oxidation, potentiometric titration in presence of tungsten	Gravimetric	Colorimetric	Gravimetric	Colorimetric	Zinc oxide–Alpha nitroso-beta naphthol	
1	0.864	[a].220	[b].027	0.010		[c].189	0.097	0.101	[d]4.13	2.05	[e]8.37		[f]1.60		8.47	
2	.860	[a].227	.025	.009	0.010	[c].176	[g].091	[h].096	4.12	[i]2.02	[j]8.41	8.44	[k]1.61		8.44	
3	.868	[a].219	.027		.007	[c].181	[l].103	.093	4.17	2.04	8.37	8.37		[m]1.58	8.52	
4	.870	[n].222	.024	.006	[o].007	.176	[l].098	[p].101	[q]4.13	2.05	[j]8.30	8.35	1.57	[m]1.54	8.41	
	.866	[a].22	[r].023	.008	[s].010	.180	[t].090	[h].107	[u]4.12	[v]2.04		8.35	[f]1.60	[m]1.60	8.47	
6		[w].214			.010	.195		[l].12	4.16	2.00	[x]8.36	8.36		[y]1.60	[z]8.54	
7	.860	[a].225	.025		[o].011	.198	[z1].098	.116	4.16	2.02	[z2]8.40		[f]1.57		[l]8.40	
8	.863	[a].21	.025		.008	[z3].200	[z4].11	[h].117	4.13	[z5]2.05	[z2]8.40		[k]1.55		8.40	
9	.863	[z6].212	.025		[s].011	[c].19	[z4].108	[h].11	4.13	2.08	[e]8.42	8.45		[m]1.58	8.41	
Averages	0.864	0.219	0.025	0.008	0.009	0.187	0.099	0.107	4.14	2.04	8.38	8.39	1.58	1.58	8.45	

[a] ZnO separation.
[b] Tungsten removed by digestion in HCl–HNO_3. Phosphorus precipitated with molybdate in hot nitric acid solution and ultimately weighed as $Mg_2P_2O_7$ after removal of arsenic.
[c] Double dehydration with perchloric acid.
[d] Persulfate oxidation, potentiometric titration with ferrous ammonium sulfate solution standardized with recrystallized potassium dichromate.
[e] Alpha-benzoinoxime method after removal of tungsten by acid digestion. Corrected for molybdenum occluded in tungsten, and the main molybdenum precipitate corrected for ammonia insoluble and tungsten. See BS J. Research **9**, 1 (1932) RP453.
[f] Single precipitation by acid digestion and cinchonine. Tungsten corrected for silicon, iron, chromium, vanadium, and molybdenum.
[g] H_2S—colorimetric method.
[h] Glyoxime precipitate titrated with cyanide.
[i] Ferrous sulfate titration with $K_3Fe(CN)_6$ indicator.
[j] H_2S–MoO_3 method.
[k] Double precipitation by acid digestion and cinchonine.
[l] Finished by electrolysis.
[m] Hydroquinone colorimetric method.
[n] Periodate-colorimetric method.
[o] SO_2 absorbed in starch-iodide solution and titrated with KIO_3 solution.
[p] Glyoxime-electrolytic method.
[q] Chromium oxidized with $KClO_3$.
[r] Tungsten, chromium and molybdenum removed, phosphorus determined by the molybdenum blue-photometric method.
[s] Sulfur gases absorbed in NaOH–H_2O_2 solution and excess NaOH titrated with H_2SO_4.
[t] Thiocyanate precipitation, thiosulfate titration.
[u] Chromium oxidized with $HClO_4$ and titrated with ferrous ammonium sulfate by using ortho-phenanthroline indicator. Corrected for partial oxidation of manganese and cobalt.
[v] Solution from titration of chromium (footnote [u]) titrated with 0.05-*N* $KMnO_4$.
[w] Chromium and colbalt removed by treatment with NH_4OH and $(NH_4)_2S_2O_8$.
[x] Molybdenum precipitated with H_2S, reduced with zinc, and titrated with $KMnO_4$.
[y] $SnCl_2$–thiocyanate colorimetric method.
[z] NaOH–ether–cupferron–electrolytic method.
[z1] Precipitated with $Na_2S_2O_3$, finished by electrolysis.
[z2] H_2S–alpha benzoinoxime method.
[z3] Double dehydration with HNO_3 and H_2SO_4.
[z4] Copper precipitated first with H_2S, then precipitated with alpha-benzoinoxime in ammoniacal solution.
[z5] Ferrous sulfate-$KMnO_4$ titration method.
[z6] Chromium volatilized as CrO_2Cl_2.

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