U. S. DEPARTMENT OF COMMERCE

National Bureau of Standards

Certificate of Analyses

OF

STANDARD SAMPLE 133

CHROMIUM-MOLYBDENUM STEEL

ANALYST	C	Mn		P		S		Si	COPPER	NICKEL	Cr	VANADIUM	Mo		NITROGEN
	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	Perchloric acid dehydration	H_2S-CuS-CuO	Weighed as nickel dimethylglyoxime	$FeSO_4$-$KMnO_4$ titration		Gravimetric	Colorimetric	
1	0.116	[b] 0.802	[c] 0.800	0.020	[d] 0.020	0.362		[e] 0.434	0.060	0.292	[f] 13.60	[g] 0.018	[h] 0.554	0.549	[i] 0.046
2	.118		[c] .785		[i] .021	.352	[k] 0.373	.440	[l] .058	.28	[m] 13.59	.024		.565	[n] .043
3	.116		[b] .782		.023	.357		.431		.283	13.59	.025	[o] .554		
4	.122		[b] .814	[p] .023	.024	[q] .354		.431	[l] .061	[r] .276	[m] 13.54	[g] .016	[h] .568		[s] .047
5	.115	.814	[b] .792		.022		[k] .369	.433	[t] .058	[r] .30	13.57	[u] .020	[v] .569	.567	[s] .047
6	.116		[c] .793	.019	[j] .019	.348	[w] .349	[e] .436	[x] .061	[y] .291	13.60	[z] .020	[v] .571	.573	[z1] .047
7	.120	[z2] .784			.022			[e] .438	.069	[y] .281	[m] 13.57	[z3] .021		.57	[z1] .044
	.110	[b] .807	[c] .808		.022	[q] .353	[k] .362	[e] .436	[l] .064	.287	13.55	[u] .021	[h] .551		[z4] .046
9	.122		[c] .798	.021	.022	.354	[k, w] .353	.433	[x] .060	.304	13.61	.014	[v] .535		.048
10	.123		[b] .80		[j] .023	.363	[w] .358	.428	[l] .057	[y] .285	[m] 13.62			.562	[s] .043
11	.121		[c] .798		.022	[q] .348	[z5] .347	.420	[t] .065	[y] .27	[f] 13.60	[g] .024	[h] .540		.046
Averages	**0.118**	**0.802**	**0.797**	**0.021**	**0.022**	**0.355**	**0.359**	**0.433**	**0.061**	**0.286**	**13.59**	**0.020**	**0.555**	**0.564**	**0.046**
General averages	**0.118**	**0.799**		**0.022**		**0.356**		**0.433**	**0.061**	**0.286**	**13.59**	**0.020**	**0.559**		**0.046**

[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 23NaOH:1P.

[b] Chromium removed by precipitation with ZnO.

[c] Chromium volatilized as CrO_2Cl_2.

[d] Colorimetric method. See J. Research NBS **26**, 405 (1941) RP1386.

[e] Double dehydration.

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

[g] Nitric acid oxidation, potentiometric titration with ferrous ammonium sulfate solution standardized with recrystallized potassium dichromate.

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

[i] Determination made by Vernon C. Holm by the vacuum fusion method. See BS J. Research **7**, 375 (1931) RP346.

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

[k] Sulfur dioxide absorbed in starch-iodide solution and titrated with KIO_3 solution standardized with standard steels.

[l] KI-$Na_2S_2O_3$ titration.

[m] Perchloric acid oxidation.

[n] Solution-distillation method. Sample dissolved in dilute sulfuric acid.

[o] Weighed as $PbMoO_4$.

[p] Weighed as ammonium phosphomolybdate.

[q] Meineke's method.

[r] Glyoxime precipitate ignited and weighed as NiO.

[s] Solution-distillation method. Sample dissolved in dilute HCl.

[t] H_2S-alpha benzoinoxime-CuO.

[u] Vanadium separated by electrolysis with a mercury cathode, and finally titrated with potassium permanganate solution.

[v] Molybdenum precipitated with H_2S and weighed as MoO_3.

[w] Sulfur gases absorbed in NaOH-H_2O_2 solution, and excess NaOH titrated with H_2SO_4.

[x] Finished by electrolysis.

[y] Glyoxime precipitate titrated with NaCN.

[z] Vanadium precipitated with cupferron, and determined by ammonium persulfate-permanganate method.

[z1] Dissolved in H_2SO_4-H_3PO_4. Selenium added and solution fumed. Distillation-titration method.

[z2] Chromium removed by precipitation with $PbNO_3$.

[z3] Chromium separated as $PbCrO_4$. Vanadium determined by differential titration with $FeSO_4$-$KMnO_4$ using o-phenanthroline indicator.

[z4] C. M. Johnson's method. See Iron Age, p. 11, July 26, 1934.

[z5] Sulfur gases absorbed in neutral H_2O_2 solution, titrated with standard NaOH solution.

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The steel for the preparation of this standard was furnished by the Republic Steel Corporation

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