Department of Commerce

Bureau of Standards

Certificate of Analyses

OF

STANDARD SAMPLE No. 30b

CHROME-VANADIUM STEEL

MATERIAL FURNISHED BY BETHLEHEM STEEL COMPANY, SOUTH BETHLEHEM, PA.

ANALYST*	C	Mn		P		S		Si	Cu	Ni	Cr		V		Mo	Co	As
	CARBON (Direct combustion)	MANGANESE 1. Bismuthate ($FeSO_4$–$KMnO_4$ titration after removing Cr and V.)	2. Other methods	PHOSPHORUS 1. Alkali-molybdate (vanadium reduced before molybdate precipitation.)	2. Gravimetric (weighed as $Mg_2P_2O_7$ after elimination of arsenic)	1. SULPHUR Gravimetric (direct oxidation and final precipitation in reduced solution)	2. SULPHUR Evolution ZnS—Iodine (theoretical sulphur titres)	SILICON Sulphuric acid dehydration	COPPER H_2S–CuS–CuO	NICKEL Weighed as nickel dimethylglyoxime	CHROMIUM 1. Persulphate oxidation ($FeSO_4$–$KMnO_4$ titration)	2. Other methods	VANADIUM 1. $FeSO_4$–$(NH_4)_2S_2O_8$–$KMnO_4$ after chromium determination[b]	2. Other methods	MOLYBDENUM	COBALT	ARSENIC
1	0.293	0.500	0.502[c]	0.024	0.024	0.032	0.030	0.215	0.134 .131[d]	0.286	1.03	1.03[e]	0.207	0.212[f]	0.018	0.024	0.021[g] .018[h]
2	.298	.504	.505[i]	.024	.024	.032[j] .033[k]	.031	.208	.141	.299	1.04	1.02[i]	.205	.218[i]	.013	.....	.....
3	.291	.....	.488[c]	.024	.....	.032	.027	.215	.144	.27[l]	1.02	.....	.....	.22[m]	.....	.....	.....
4	.299	.501	.511[n]	.023	.....	.033	.028	.211	.139 .129[d]	.291	1.03	.....	.206	.199[f] .202[o]	.012	.....	.....
5	.288	.505	.51[p]	.024	.....	.033	.032	.204[q] .207	.125	.291 .293[r]	1.01	.....	.20	.....	.012	.....	.....
6	.30	.50	.49[p] .49[s]	.....	.....	.032	.....	.214[t] .213	.126[d]	.29[u] .29[r]	1.01	1.02[v]	.....	.....	.015	.....	.....
7	.301	.496	.496[n] .494[p]	.026	.....	.032	.030	.205[q] .206	.12	.....	1.03	.....	.....	.20[w]	.....	.....	.....
	.285	.51	.....	.026	.026	.032	.028	.215	.124	.29	1.04	.....	.....	.206[a1] .210[f]	.....	.....	.....
9	.286	.501	.....	.022	.....	.032 .033[j]	.....	.219[q] .215	.133[d]	.256	1.05	1.05[x]	.....	.210[e] .201[o]	.....	.....	.....
10	.288	.496	.....	.024	.....	.030	.029	.220	.111[d] .122	.28[u] .269	.....	1.01[y]	.198	.200[z]	.....	.....	.....
11	.294	.494	.....	.023	.....	.030[j] .031	.....	.218	.146	.....	.....	1.01[i]	.....	.218[i]	.....	.....	.....
12	.285	.....	.50[p]	.022	.....	.032	.030	.21	.....	.25	1.02	.....	.217	.218[a1]	.....	.....	.026
13	.290	.....	.492[z]	.023	.....	.033[j]	.....	.217	.133[a2] .127[z]	.288[r] .291[z]	.....	1.01[z]	.....	.218[a3]	.....	.....	.....
AVERAGES	.292	.501	.498	.024	.025	.032	.029	.212	.130	.282	1.03	1.02	.206	.209	.014	.024	.022
General Averages	.292	.499		.024		.032†	.029	.212	.130	.282	1.03		.208†		.014	.024	.022

NOTE.—By the use of methods employing empirical titres for evolution sulphur, an average of 0.032% was obtained by six analysts.

† Recommended values: 0.215% vanadium; .032% sulphur.
[a] Value obtained by standardization of titrating solution against sodium oxalate through $KMnO_4$ and $Na_2S_2O_3$.
[b] Described in "Methods of the U. S. Steel Corporation for the Sampling and Analysis of Alloy Steels," 1921, page 47, and in A. S. T. M., "Proposed Tentative Methods of Chemical Analysis of Alloy Steels," serial designation A55-22T.
[c] Bismuthate-arsenite.
[d] Finished by electrolysis.
[e] Peroxide fusion method.
[f] Modification of J. R. Cain's method. Reprint 161 from Bulletin of the Bureau of Standards, vol. 7, No. 3, and J. Ind. & Eng. Chem. 3, 476 (1911).
[g] Weighed as As_2S_3.
[h] Converted the sulphide to arsenate, precipitated as Ag_3AsO_4, dissolved in HNO_3 and titrated with KCNS.
[i] Electrometric titration.
[j] Precipitated in $FeCl_3$ solution.
[k] Same result obtained by Meineke's method.
[l] Weighed as NiO.
[m] Garratt's method. J. Ind. & Eng. Chem. 4 (1912), 256. Same result obtained by Blair's method. Blair, "The Chemical Analysis of Iron," 7th edition, p. 209.
[n] Ford Williams' method.
[o] Cain & Hostetter's method.
[p] Persulphate–arsenite.
[q] Solution in HNO_3 and H_2SO_4.
[r] Dissolved the glyoxime precipitate and titrated with KCN.
[s] ZnO separation–persulphate arsenite.
[t] Solution in HCl and $HClO_4$.
[u] Direct KCN titration.
[v] HNO_3–$NaClO_3$.
[w] HCl reduction.
[x] Barba's method.
[y] Bismuthate oxidation—$KMnO_4$ titration.
[z] Johnson's method. Johnson, "Chemical Analysis of Special Steels, etc.," 3d edition.
[a1] Color method.
[a2] KCN titration.
[a3] Johnson's method after removal of copper.

*INDEX TO ANALYSTS

1. James I. Hoffman, Bureau of Standards.
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3. A. S. Townsend, The Cleveland Twist Drill Co., Cleveland, Ohio.
4. G. H. Corey and L. R. Shropshire, Ledoux & Co., New York City.
5. W. D. Brown, Carnegie Steel Co., Duquesne, Pa.
   John L. Harvey, Carnegie Steel Co., Munhall, Pa.
7. H. A. Hosmer, Cambria Steel Co., Johnstown, Pa.
8. William Brady, Illinois Steel Co., South Chicago, Ill.
9. M. E. McDonnell, The Pennsylvania System, Altoona, Pa.
10. H. Morrison and A. S. Anderson, Dodge Bros., Detroit, Mich.
11. E. A. Loos, Carpenter Steel Co., Reading, Pa.
12. J. H. Campbell, Robert W. Hunt & Co., Chicago, Ill.
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