UNITED STATES DEPARTMENT OF COMMERCE
WASHINGTON

National Bureau of Standards
Certificate of Analyses

Standard Sample 132 A
Molybdenum—Tungsten—Chromium—Vanadium Steel

ANALYST	C	Mn	P	S		Si	Cu	Ni	Cr	V	Mo		W	
	Direct combustion	Persulfate-Arsenite	Alkali-Molybdate [a]	Gravimetric (direct oxidation and final precipitation after reduction of iron)	Combustion	Nitric-sulfuric acid dehydration	Colorimetric	Weighed as nickel dimethylglyoxime	Persulfate oxidation ($FeSO_4$-$KMnO_4$ titration)	HNO_3 oxidation, potentiometric titration in presence of tungsten	Gravimetric	Colorimetric	Gravimetric	Colorimetric
1	0.822	[b] 0.270	[c] 0.030		[d] 0.005	[e] 0.190	[f] 0.119	0.140	4.22	1.95	[g] 4.51		[h] 6.19	
2	[i] .832	.265	.026	.006	.008	.19	[j] .118	[k] .142	4.20	1.94	[g] 4.56		6.23	6.18
3	.825	[l] .278	[m] .032	.006	[n] .005	[o] .194	[p] .120	[k] .132	4.22	1.95		4.52	6.29	6.27
4	[i] .819	[l] .258	.028	.007		[q, e] .182	[p] .112	[r] .133	[s] 4.18	1.93	[t] 4.46		6.07	
5	.829	[u] .266	[v] .028	.004	[w] .005	[o] .196	[f] .124	[k] .137	[s] 4.23	1.92		4.50		6.16
6	[i] .831	[x] .269	[c] .030		[d] .007	[q] .186	[f] .120	.135	4.20	1.94	[t] 4.48	4.48	[h] 6.24	6.20
7	[i] .823	[l] .271	[m] .028		[n] .007	.191	[f] .124	[y] .143	[s] 4.21	1.93		4.52		6.21
8	[i] .821	[z] .262	[c] .029	.004	[w] .005	[e] .187	[f] .120	[z1] .138	4.22	[z2] 1.92		4.47	[z3] 6.23	
9	[z4, i] .820	[l] .275	.029		[w] .007	[o] .192	[f] .125	[k] .130	4.18	1.94	[g] 4.57		[h] 6.17	
Average	0.825	0.268	0.029	0.005	0.006	0.190	0.120	0.137	4.21	1.94	4.52	4.50	6.20	6.20
General average	0.825	0.268	0.029	0.006		0.190	0.120	0.137	4.21	1.94	4.51		6.20	

[a] Precipitated at 40° C, washed with a 1-percent solution of KNO_3 and titrated with alkali.
[b] Potentiometric titration.
[c] Gravimetric. Molybdate—$Mg_2P_2O_7$.
[d] 1-g sample burned in oxygen at 1,425° C. Sulfur dioxide absorbed in starch-iodine solution. Titration with standard KIO_3 solution based on 93 percent of the theoretical factor.
[e] Double dehydration with intervening filtration.
[f] Diethyldithiocarbamate method. See J. Research NBS **47**, 380 (1951). RP2265.
[g] Alpha-benzoinoxime-MoO_3 method. See BS J. Research **9**, 1 (1932). RP453.
[h] Tungsten precipitated by acid digestion and cinchonine. Ignited WO_3 corrected for silicon, iron, chromium, vanadium, and molybdenum.
[i] Burned with tin.
[j] Copper precipitated as CuCNS. Titrated with KI-$Na_2S_2O_3$.
[k] Dimethylglyoxime precipitate titrated with cyanide.
[l] Chromium separated with ZnO.
[m] Titrating solution standardized with a standard steel.
[n] Combustion gases absorbed in NaOH-H_2O_2. Solution titrated with H_2SO_4.
[o] Perchloric acid dehydration.
[p] Copper-ammonia complex.
[q] Nitric-hydrochloric acid dehydration.
[r] Dimethylglyoxime precipitate ignited to NiO.
[s] Chromium oxidized by phosphoric-perchloric acid mixture.
[t] Molybdenum precipitated with H_2S in acid solution containing tartaric or citric acid, and weighed as MoO_3.
[u] Periodate-colorimetric method after volatilization of chromium as CrO_2Cl_2.
[v] Molybdenum-blue photometric method.
[w] As in (d) with tin as an accelerator.
[x] ZnO-periodate colorimetric method.
[y] Dimethylglyoxime-photometric method.
[z] Periodate-method, direct. See ASTM Method E30-55T.
[z1] Photometric dimethylglyoxime method. See Anal. Chem. **23**, 875 (1951).
[z2] Photometric phosphotungstovanadate method. See Anal. Chem. **21**, 605 (1949).
[z3] Major portion of tungsten precipitated by hydrolysis and cinchonine in HCl-HNO_3 solution. Alpha benzoinoxime added. Precipitate filtered, ignited to constant weight at 500° C. Corrected for silicon, NaOH-insoluble, and MoO_3 (calculated from percentage of molybdenum obtained on a separate sample).
[z4] Volume of evolved CO_2 measured.

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The steel for the preparation of this standard was furnished by the Universal-Cyclops Steel Corp., Bridgeville, Pa.

WASHINGTON, D. C., March 1, 1955. A. V. ASTIN, *Director.*

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