

U. S. DEPARTMENT OF COMMERCE

National Bureau of Standards

Certificate of Analyses

OF

STANDARD SAMPLE 50B

TUNGSTEN—CHROMIUM—VANADIUM STEEL

ANALYST*	C	Mn	P	S		Si	COPPER H ₂ S-CuS-CuO	NICKEL Weighed as nickel dimethylglyoxime	Cr	V	MOLYBDENUM Colorimetric	W	TIN	ARSENIC
	Direct combustion	Persulfate-Arsenite	Alkali-Molybdate	Gravimetric (direct oxidation and precipitation after reduction of iron)	Combustion	Perchloric acid dehydration			FeSO ₄ -KMnO ₄ titration	HNO ₃ oxidation, potentiometric titration in presence of tungsten		18.07	18.00	18.02
1	0.732	^a 0.323	^b 0.029	0.008		^c 0.296	0.114	0.089	^d 4.10	1.02	0.402	^e 18.07	^f 0.026	^g 0.042
2	.727	^h .33	ⁱ .030		0.007	.28	.115	.089	^j 4.03	1.01	^k .384	18.00	.025	.042
3	.730	^l .313	^m .028	.006	ⁿ .008	.297	^o .104	.093	^p 4.09	^q 1.02	.414	^r 18.02	^s .025	^t .047
4	.724	.329	.031		.008	.298	.102	.094	4.07	1.03	.392	18.10	.024	
5									4.06	1.03	.40	18.07		
6	.735	^u .332	^v .026	.007		^w .278	.104	^x .092	4.09	^y 1.02	.400	18.04		
	.727	.33	.030	.009		.303	.108	.095	4.08	1.03	.389	18.14	.029	
	.730	^z .332	.028	.008		^{aa} .290	.107	^{ab} .083	4.12	^{ac} 1.02	.409	^{ad} 18.07	^{ae} .021	^{af} .040
9	.726	^{ag} .319	^{ah} .031		^{ai} .005	^{aj} .206	^{ak} .105	^{al} .085	^{am} 4.10	^{an} 1.00	.415	^{ao} 18.08		
10	.724	^{ap} .33	^{aq} .028		.008	.30	.127	^{ar} .084	^{as} 4.10	^{at} 1.00	.405	^{au} 17.95		
11	.725	^{av} .31	.030	.005	^{aw} .007	^{ax} .302	.115	^{ay} .088	^{az} 4.09	^{ba} 1.02	.397		^{bb} .026	^{bc} .033
Averages	0.728	0.325	0.029	0.007	0.007	0.294	0.110	0.089	4.08	1.02	0.401	18.05	0.025	0.041
General average	0.728	0.325	0.029	0.007	0.007	0.294	0.110	0.089	4.08	1.02	0.401	18.05	0.025	0.041

^a Bismuthate (FeSO₄-KMnO₄) method after ZnO separation.
^b Tungsten removed by digestion in HCl-HNO₃. Phosphorus precipitated with molybdate in a hot nitric acid solution, and ultimately weighed as Mg₂P₂O₇ after removal of arsenic. Includes 0.005-percent phosphorus occluded in the tungstic acid precipitate.
^c Nitric-sulfuric acid dehydration.
^d Persulfate oxidation, potentiometric titration with ferrous ammonium sulfate solution standardized with potassium dichromate.
^e Single precipitation by acid digestion (HCl-HNO₃) and cinchonine. Tungsten corrected for silicon, iron, chromium, vanadium, and molybdenum.
^f Determination made by R. K. Bell by the sulfide-iodine method. See BS J. Research 7, 375 (1931) RP346.
^g Determination made by K. D. Fleischer by the molybdenum-blue photometric method. See J. Research NBS 24, 7 (1940) RP1267.
^h Bismuthate-arsenite method.

ⁱ Titrating solution standardized by use of a standard steel.
^j Permanganate oxidation.
^k H₂S-MoO₃ method.
^l ZnO separation.
^m Tungsten removed, and phosphorus precipitated as the molybdate in hot, strong nitric acid solution.
ⁿ Sulfur gases absorbed in NaOH-H₂O₂ solution, and excess NaOH titrated with H₂SO₄.
^o Copper precipitated as CuCNS. Finished by KI-Na₂S₂O₃ titration.
^p Chromium oxidized by phosphoric acid-perchloric acid mixture and titrated by FeSO₄-KMnO₄ procedure using orthophenanthroline indicator. Vanadium then titrated with KMnO₄.
^q As in footnote e, except rhodamine B used to precipitate unhydrolyzed tungstic acid.
^r Sulfide-iodine method.
^s Distillation-permanganate method.
^t Nitric-hydrochloric acid dehydration.

^u Glyoxime precipitate ignited to NiO.
^v FeSO₄-(NH₄)₂S₂O₈-KMnO₄ method.
^w Volhard-arsenite method.
^x Glyoxime precipitate titrated with alkali cyanide.
^y Ferrous sulfate titration with K₃Fe(CN)₆ indicator.
^z Distillation-As₂S₃ method.
^{aa} Chromium volatilized as CrO₂Cl₂.
^{ab} Vanadium reduced to V⁴ before precipitation of phosphorus with molybdate.
^{ac} Finished by electrolysis.
^{ad} Chromium separated as PbCrO₄.
^{ae} Perchloric acid oxidation.
^{af} Chromium separated as PbCrO₄, and vanadium titrated with KMnO₄ after the addition of phosphoric acid-potassium phosphate solution.
^{ag} Chromium removed by precipitation with NaHCO₃.
^{ah} Sulfur gases absorbed in neutral H₂O₂ and H₂SO₄ titrated with NaOH standardized with standard steels.
^{ai} Distillation-bromate titration method.

*LIST OF ANALYSTS

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| <ol style="list-style-type: none"> 1. Ferrous Laboratory, National Bureau of Standards, Washington 25, D. C. John L. Hague in charge. Analysis by John P. Hewlett, Jr. and James I. Shultz. 2. Daniel Harmon, Allegheny-Ludlum Steel Corporation, Dunkirk, N. Y. 3. O. L. Van Valkenburgh, Crucible Steel Company of America, Halcomb Steel Division, Syracuse, N. Y.
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WASHINGTON, November 20, 1944.

LYMAN J. BRIGGS, *Director.*