

National Bureau of Standards Certificate of Analyses

Standard Sample 19G Acid Open-Hearth Steel, 0.2% Carbon

ANALYST	C	Mn	P	S	Si	Cu	Ni	Cr	V	Mo	Nb	Sn	Al	Ti	Co		
	Direct combustion	Persulfate-Arsenite	Gravimetric (weighed as MgP ₂ O ₇ after removal of arsenic)	Gravimetric (direct oxidation and precipitation after reduction of iron)	Combustion Iodate titration	Perchloric acid dehydration	Weighed as nickel dimethylglyoxime	FeSO ₄ -KMnO ₄ titration	Photometric	Total	H ₂ O ₂ photometric	Photometric Nitroso-R-salt					
1.....	0.226	^a 0.558	0.046 ^b	0.049	0.032 ^c	0.032	^d 0.186	^e 0.090	0.067	^f 0.377	^g 0.012	0.013	^h 0.027	ⁱ 0.008	^j 0.027	^k 0.029	0.012
2.....	.225	.557	.045	1.045	.033	.034	^d .184	{ ^m .092 ⁿ .093}	{ ^o .062 ^p .064}	{ ^q .369 ^r .371}	^s 0.10	.012	^t .028	^u 1.009	{ ^v .031 ^w .033}	{ ^x .029 ^y .027}	^z .011
3.....	.221	^w .552		1.045		.034	.189	^x .100	^o .071	{ ^p .371 ^q .370}	^r 0.14	.011	^s .024	^t .008	^u .032	.028	
4.....	.221	^w .559	^v .052			^w .033	^d .180	^m .089	.066	^f .376	^g 0.14	.013	^h .025		ⁱ .029	.024	
	.219	^w .55		1.044		^w .035	^d .189	^m .094	^o .066	.380		^g .015	^h .021	.009	.032	^h .024	
	.220			b.046		.031	.185	^e .097	^o .06			.015					
	^v .230	^w .550		1.046		^w .034	^d .191	ⁿ .091	.068	.376	^g 0.11	.013	^h .030	.008	ⁱ .031	.026	
Average.....	0.223	0.554	0.048	0.046	0.032	0.033	0.186	0.093	0.066	0.374	0.012	0.013	0.026	0.008	0.031	0.027	0.012
General average.	0.223	0.554	0.046		0.033		0.186	0.093	0.066	0.374	0.012	0.013	^k 0.026	0.008	0.031	0.027	0.012

^a Potentiometric titration.
^b Molybdenum-blue photometric method. See J. Res. NBS 26, 405 (1941) RP1386.
^c 1-g sample burned in oxygen at 1,450 °C, and sulfur dioxide absorbed in starch-iodide solution. Iodine liberated from iodide by titration, during the combustion, with standard KIO₃ solution. Titer based on 93 percent of the theoretical factor.
^d Double dehydration.
^e Diethyldithiocarbamate photometric method. See J. Res. NBS 47, 380 (1951) RP2265.
^f Persulfate oxidation and potentiometric titration with ferrous ammonium sulfate.
^g Mercury cathode. Vanadium oxidized with HNO₃ and titrated potentiometrically with ferrous ammonium sulfate.
^h Ion-exchange. Hydroquinone photometric method. See J. Res. NBS 62, 1 (1959) RP2923.
ⁱ Sulfide-iodine method. See BS J. Res. 8, 309 (1932) RP415.

^j Mercury cathode-cupferron-aluminon photometric method. See J. Res. NBS 64a, No. 3, 235 (1960).
^k Cupferron separation after solution of the sample in diluted HCl (1+2). Vanadium separated by treatment with NaOH.
^l Alkali-molybdate method.
^m Electrolytic method.
ⁿ Neocuproine photometric method.
^o Photometric method.
^p Perchloric acid oxidation.
^q Cupferron-FeSO₄-(NH₄)₂S₂O₈-KMnO₄.
^r Cupferron-ion-exchange-Nb₂O₅ gravimetric method.
^s Ether-mercury cathode-8 hydroxyquinoline-Al₂O₃.
^t Ether-cupferron-eriochrome cyanine R photometric method.
^u Ether-cupferron-H₂S-cupferron-TiO₂.
^v Chromium removed with ZnO.
^w Titrating solution standardized by use of a standard steel.
^x Diethyldithiocarbamate photometric method.
^y NaHCO₃-FeSO₄-(NH₄)₂S₂O₈-KMnO₄.

^z Niobium hydrolyzed with HClO₄ and H₂SO₄. ASTM method E30-56.
^{aa} Tin preferentially precipitated with ammonium hydroxide in the presence of ferrous iron, solution of the precipitate is reduced with Stanredue and titrated with standard iodate.
^{ab} Cr₂O₃-ether-aluminon photometric method.
^{ac} Weighed as ammonium phosphomolybdate.
^{ad} Sulfuric acid dehydration.
^{ae} Nitric acid oxidation and potentiometric titration with ferrous ammonium sulfate.
^{af} Weighed as AlPO₄.
^{ag} H₂SO₄ hydrolysis-tannic acid-pyrogallol photometric method.
^{ah} Vanadium separated with Na₂CO₃.
^{ai} Differential gasometric method.
^{aj} Mercury cathode-cupferron-eriochrome cyanine R photometric method.
^{ak} Values reported for niobium by analysts 3, 4, 5, and 7 include small amounts of tantalum present in the sample.

List of Analysts

1. Ferrous Laboratory, National Bureau of Standards. J. I. Shultz, in charge. Analysis by B. B. Bendigo and J. I. Shultz.
2. R. H. Rouse, Bethlehem Steel Co., Sparrows Point Plant, Sparrows Point, Md.
3. H. W. Huston, A. M. Byers Co., Ambridge, Pa.
A. Trathowen, Jones and Laughlin Steel Corp., Pittsburgh, Pa.

5. D. P. Robertson, Weirton Steel Co., Weirton, W. Va.
6. W. E. Walters, Pittsburgh Testing Laboratory, Pittsburgh, Pa.
7. W. F. Horscroft, Bethlehem Steel Co., Homer Research Laboratory, Bethlehem, Pa.

The steel for the preparation of this standard was furnished by the Bethlehem Steel Co., Bethlehem, Pa.

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