

UNITED STATES DEPARTMENT OF COMMERCE
WASHINGTON

National Bureau of Standards
Certificate of Analyses
Standard Sample 16D
Basic Open-Hearth Steel, 1.0% Carbon

ANALYST	C	Mn		P	S			Si	Cu	Ni	Cr	V	Mo	N	
	Direct combustion	Bismuthate (FeSO ₄ -KMnO ₄)	Persulfate-Arsenite	Gravimetric (weighed as Mg ₂ P ₂ O ₇ after removal of arsenic)	Alkali-Molybdate ^a	Gravimetric (direct oxidation and precipitation after reduction of iron)	Combustion Iodate titration	Evolution with HCl (1-1) ZnS-Iodine (theoretical sulfur titer) ^b	Perchloric acid ^c dehydration	H ₂ S-CuS-CuO	Weighed as nickel dimethylglyoxime	Persulfate oxidation (FeSO ₄ -KMnO ₄ , titration)		Colorimetric	Distillation-titration
1	1.01	.444	0.444	0.013	0.014	0.033	0.032	0.033	0.185	0.054	0.022	0.044	0.002	0.006	0.003
2	1.00	.443		0.013		.030			1.193	.051	.022	.042	.003	.005	.003
3	1.02	.438		.014		.033	0.032		1.196	.056	.018				.004
4	1.02		{ 0.438 0.435 }	0.014		0.032	0.030		{ 1.18 1.18 }	0.050	0.023	0.040		<.005	.004
5	1.01		0.43		0.015		0.032		1.191	0.046	0.023	0.042	0.004	0.006	
6	1.02					0.038				0.046	0.024	0.042		0.005	
7	1.01		.450	0.013	0.013	0.036	{ 0.035 0.033 }	0.036	{ 1.195 1.188 }	0.056	0.024	0.044	0.004	0.004	0.003
8	1.00	.44	0.43	0.015	0.014	0.033	0.032		.189	{ 0.052 0.051 }	0.024	0.046	0.001	0.006	0.003
9	1.01		0.445		0.015			0.034	1.181	0.053	0.022	0.039	0.001	0.009	
Average	1.01	0.440	0.439	0.014	0.014	0.033	0.033	0.034	0.188	0.052	0.022	0.042	0.002	0.006	0.003
General average	1.01	0.439		0.014		0.033			0.188	0.052	0.022	0.042	0.002	0.006	0.003

^a Precipitated at 40° C, washed with a 1-percent solution of KNO₃ and titrated with alkali standardized by the use of acid potassium phthalate and the ratio 23NaOH:1P.
^b Value obtained by standardizing the titrating solution by means of sodium oxalate through KMnO₄ and Na₂S₂O₈, and use of the ratio 21:1S.
^c Potentiometric titration.
^d Molybdenum-blue photometric method. See J. Research NBS 26, 405 (1941) RP1386.
^e 1-g sample burned in oxygen at 1425° 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.
^f Double dehydration with H₂SO₄.
^g Diethyldithiocarbamate photometric method. See J. Research NBS 47, 380 (1951) RP2265.
^h Chromium separated from the bulk of the iron in a 10-g sample by NaHCO₃ hydrolysis, oxidized with persulfate and titrated potentiometrically with ferrous ammonium sulfate.

ⁱ Vanadium separated as in (b), oxidized with HNO₃ and titrated potentiometrically with ferrous ammonium sulfate.
^j Sulfuric acid digestion for 4 hours of a 0.5-g sample. See J. Research NBS 43, 201 (1949) RP2021.
^k Weighed as ammonium phosphomolybdate.
^l Double dehydration with intervening filtration.
^m Spectrographic determination.
ⁿ Combustion gases absorbed in neutral peroxide solution and titrated with sodium borate.
^o Titrating solution standardized by use of a standard steel.
^p Finished by electrolysis.
^q Periodic photometric method. See British Standard 1121, part 23 (1951).
^r ZnO separation-persulfate oxidation, titration with FeSO₄-K₂Cr₂O₇, using sodium diphenylamine sulfonate indicator. See British Standard 1121, part 16 (1949).
^s Ammonium phosphomolybdate-lead molybdate method.
^t Iron reduced with hydroxylamine hydrochloride before precipitation of BaSO₄. See The Analyst 80, 796 (1955).

^u Molybdenum-blue photometric method.
^v 2,2' diquinolyl colorimetric method.
^w Dimethylglyoxime photometric method.
^x Diphenylcarbazide photometric method.
^y Vanadium separated by NaHCO₃ and determined photometrically with H₂O₂.
^z Differential gasometric method.
^{aa} Combustion gases absorbed in neutral H₂O₂ solution titrated with standard NaOH using methyl red indicator.
^{ab} Molybdenum-blue photometric method. See Anal. Chem. 23, 1496 (1951).
^{ac} Silico-molybdate photometric method. See Anal. Chem. 21, 589 (1949).
^{ad} Diethyldithiocarbamate photometric method.
^{ae} Vanadium precipitated with cupferron and determined by phosphotungstovanadate photometric method.
^{af} Finished photometrically using Nessler's reagent.
^{ag} Ether separation of iron on a 10-g sample. Dimethylglyoxime precipitate titrated with cyanide.
^{ah} Nitric-sulfuric acid dehydration.
^{ai} Copper precipitated with Na₂S₂O₄.

List of Analysts

1. Ferrous Laboratory, National Bureau of Standards. Analysis by J. I. Shultz, R. E. McIntyre, E. June Maienthal, and Lorna J. Tregoning.
2. A. J. Herdle, United States Steel Corp., Youngstown District, Youngstown, Ohio.
3. H. J. Wolthorn, United States Steel Corp., Fairless Works, Fairless Hills, Pa.
4. I. Borrowdale and G. E. Speight, Richard Thomas and Baldwins Ltd., RTSC Laboratories, Whitchurch, Aylesbury, Bucks, England.
5. D. P. Robertson, Weirton Steel Co., Weirton, W. Va.
6. C. Ferguson, Materials Division, Research and Test Department, U. S. Naval Ordnance Plant, Indianapolis, Ind.
7. R. L. Harbaugh, Inland Steel Co., Indiana Harbor Works, East Chicago, Ind.
8. W. F. Zollinger, Bethlehem Steel Co., Bethlehem, Pa.
9. L. J. Jones, Republic Steel Corp., Bessemer Laboratory, Youngstown, Ohio.

The steel for the preparation of this standard was furnished by the United States Steel Corp.

WASHINGTON, D. C., June 1, 1956. Recd 8/17 PC 7/29/56

A. V. ASTIN, Director.