UNITED STATES DEPARTMENT OF COMMERCE
WASHINGTON 25, D. C.

National Bureau of Standards

Certificate of Analyses

Standard Samples 1040, 1041, 1042, 1043, 1044, 1045, 1046, 1047

Iron and Plain Carbon Steels for Oxygen and Nitrogen

Sample number	Type	Additions			Composition, weight percent									Original number[1]
		Furnace	Ladle	Mold	O	N	C	Mn	P	S	Si	Cr	V	
1040	Low-carbon, rimming..	None	FeMn	None	**0.018**	**0.003**	0.03	0.3	0.01	0.04	0.002	0.004	<0.001	1
1041	Medium-carbon, high-manganese, silicon-killed.	FeMn	Hot metal, FeMn, FeSi	None	**.017**	**.004**	.4	1.2	.02	.03	.3	.02	< .001	2
1042	Bessemer screw stock, rimming.	None	FeMn, S	FeSi	**.017**	**.014**	.1	0.7	.1	.2	.02	.006	.004	3
1043	Special, low-carbon, aluminum-killed.	SiMn, FeMn	FeSi, Al	None	**.002**	**.005**	.2	.6	.01	.03	.09	.01	.001	4
1044	Low-carbon, silicon-killed.	None	FeMn, FeSi	None	**.009**	**.004**	.2	.4	.02	.04	.1	.02	.001	5
1045	Medium-carbon, silicon-killed.	Spiegel	FeMn, FeSi	None	**.007**	**.004**	.4	.5	.01	.03	.2	.01	< .001	6
1046	Open-hearth iron, rimming.	None	Al	None	**.106**	**.005**	.02	.02	.01	.02	.001	.01	< .001	7
1047	Similar to No. 1043 but higher in oxygen.	None	Al	Al	**.017**	**.004**	.2	.4	.01	.03	.03	.01	< .001	8

[1] The numbers 1 through 8 in the last column refer to the original numbers given to these samples which are described in the following references:

National Bureau of Standards Journal of Research **18,** 266 (1937); and
Transactions, American Institute of Mining and Metallurgical Engineers, Iron and Steel Division **125,** 216 (1937).

A single certificate is issued for the eight samples identified above. Numbers corresponding to those in the first column are stamped on the end of individual samples to identify them with the analyses here given.

The samples are certified only for the elements, oxygen and nitrogen; the percentages of the other elements are given as a guide to the type of iron or steel. These samples are not certified for spectrographic standards.

In preparation of samples it is recommended that sample 1046 be reduced in diameter to 1.25 in. and the diameter of the other steels be reduced to 0.95 in. in a lathe just before preparing the analytical samples.

A list of the original cooperating laboratories and the methods employed by each is given on the back of this certificate.

A. V. ASTIN, *Director.*

WASHINGTON, D. C., December 6, 1957.

Cooperating Laboratories and Methods Employed

Laboratory	Method
1. Battelle Memorial Institute, Columbus, Ohio; S. Epstein, Metallurgist.	Microscopic examination and inclusion count, Metals & Alloys **2**, 186 (1931).
2. United States Steel Corp., Kearny, N. J., John Johnston, Director of Research; T. E. Brower, B. M. Larsen.	Hydrogen-reduction method, Trans. AIME **113**, 61 (1934)
3. Mining and Metallurgical Advisory Boards to the Carnegie Institute of Technology, Pittsburgh, Pa., C. H. Herty, Jr., Dir. Res.; J. F. Sanderson & B. E. Sockman.	Electrolytic method as described by Fitterer et al., U. S. Bureau of Mines Report of Investigations 3205 (May 1933).
4. Inland Steel Co., Indiana Harbor, Ind. Frank W. Scott.	Electrolytic method, Ind. Eng. Chem., Anal. Ed. **4**, 121 (1932).
5. British (Guest Keen Baldwins) Iron and Steel Co., Ltd., Port Talbot, Wales. F. F. Hunting, Chief Metallurgist; N. Gray, Chief Chemist.	Hydrogen-reduction method; sample melted with antimony and tin.
6. Babcock and Wilcox Tube Co., Beaver Falls, Pa., Newell Hamilton, Research Metallurgist.	Vacuum-fusion method, Trans. AIME **113**, 111 (1934).
7. Bethlehem Steel Co., Inc., Bethlehem, Pa., P. E. McKinney, Metallurgical Engineer; George F. Stammler.	Iodine method, essentially that of Cooperator No. 13.
8. Department of Engineering Research, University of Michigan, Ann Arbor, Mich.; John Chipman, Research Engineer; M. G. Fontana and C. L. Raynor.	Vacuum-fusion method, Ind. Eng. Chem., Anal. Ed. **7**, 391 (1935).
9. English Steel Corp., Ltd., Sheffield, England; T. R. Walker, Chief Research Chemist.	Iodine method of Cooperator No. 13, Nitric acid residue method, J. Iron Steel Inst. **113**, 177 (1926).
10. Lukens Steel Co., Coatesville, Pa. W. G. Hampton, Metallurgical Engineer.	Iodine method. Solution by Willems' method Arch. Eisenhüttenw. **1**, 655 (1928); Analysis of residue by method of Cooperator No. 13.
11. Research Institute for Iron, Steel and other Metals, Sendai, Japan. T. Ishiwara, Director; T. Yajima.	Vacuum-fusion method. Includes features of several procedures.
12. SKF Industries, Inc., Philadelphia, Pa. Haakon Styri, Director of Research.	Electrolytic method, Trans. AIME **105**, 185 (1933); Metals & Alloys **5**, 96 (1934).
13. Electro Metallurgical Co., Niagara Falls, N. Y. Thomas R. Cunningham.	Iodine method of Cunningham and Price. Ind. Eng. Chem., Anal. Ed. **5**, 27 (1933).
14. Bell Telephone Lab., New York, N. Y. J. H. Scaff.	Vacuum-fusion method, Metals & Alloys **4**, 7 (1933).
15. Kaiser-Wilhelm Institut für Eisenforschung, Düsseldorf, Germany. F. Körber, Director.	Vacuum-fusion method, Mitt. Kaiser-Wilhelm Inst. f. Eisenforsch, Düsseldorf **13**, 215 (1931); Chlorine method, *ibid* **9**, 195 (1927).
16. Ontario Research Foundation, Toronto, Canada. O. W. Ellis, Director of Metallurgical Research; J. R. Gordon, Research Metallurgist.	Iodine method of Cooperator No. 13.
17. Kohle u. Eisenforschung GMBH Forschungsinstitut, Dortmund, Germany. E. H. Schulz, Director.	Chlorine method, Mitt. Forsch. Inst. Ver. Stahlwerke A. G. Dortmund **1**, 231 (1930); Chem. Fabrik **2**, 51 (1929), Hydrogen-reduction method; Stahl u. Eisen **40**, 812 (1920); Arch. Eisenhüttenw. **3**, 459 (1929–30).
18. Metallografiska Institutet, Stockholm, Sweden, Carl Benedicks, Director; G. Phragmén, Metallographer.	Vacuum-fusion method, Jernkontorets Ann. **114**, 549 (1931)
19. American Rolling Mill Co., Middletown, Ohio. A. H. Thomas, Supervisor, Service Testing Laboratories; D. L. Reck, Res. Engr.; & O. B. Ellis, Chemist.	Electrolytic method of Cooperator No. 3. Iodine method of Cooperator No. 13.
20. Fried. Krupp Aktiengesellschaft Guszstahl-fabrik, Essen, Germany. P. Klinger, Chief Chemist.	Vacuum-fusion method, presumably, Arch. Eisenhüttenw. **6**, 189 (1932), Analysis as described in Stahl u. Eisen **45**, 1559 (1925); Chlorine method, Arch. Eisenhüttenw. **7**, 618 (1933–34); Mercuric chloride method, *ibid* **8**, 391 (1934–35); Electrolytic methods, (A.) Ind. Eng. Chem. Anal. Ed. **4**, 121 (1932); (B.) Jernkontorets Ann. **116**, 166 (1932).
21. Instituto Scientifico Tecnico Ernesto Breda, Milano, Italy.	Vacuum-fusion method, Arch. Eisenhüttenw. **6**, 189 (1932); Iodine method, essentially method of Cooperator No. 13.
22. United Steel Companies, Ltd, Stocksbridge, England. T. Swinden, Director of Research.	Iodine method of Rooney and Stapleton, J. Iron Steel Inst. **131**, 249 (1935).
23. Westinghouse Electric and Mfg. Co., East Pittsburgh, Pa. T. D. Yensen, Manager, Magnetic Division; Wilson Scott, and N. A. Ziegler.	Vacuum-fusion method. Trans. Am. Electrochem. Soc. **62**, 109 (1932).
24. A. O. Smith Corporation, Milwaukee, Wis. S. L. Hoyt, Director of Metallurgical Research; and M. A. Scheil, Research Metallurgist.	Fractional vacuum-fusion method, Trans. AIME **113**, 82 (1934); Microscopical examination, Trans. AIME **116**, 405 (1935).
25. Babcock and Wilcox Co., Barberton, Ohio. J. B. Romer, Chief Chemist.	Mercuric chloride method, Arch. Eisenhüttenw. **8**, 391 (1934–35).
26. School of Mines, Columbia University, New York, N. Y. William Campbell, Prof. of Metallurgy; & S. W. Poole.	Microscopical examination.
27. Department of Metallurgy, University of Sheffield, Sheffield, Eng. J. H. Andrew, Prof. of Metallurgy.	Iodine and vacuum-fusion methods, Iron Steel Inst., 6th Rept. of the Heterogeneity of Steel Ingots (1935) sec. 3, 50, and 61.
28. Youngstown Sheet and Tube Co., Youngstown, Ohio. G. A. Reinhardt, Director of Research and Metallurgy; Francis M. Walters, Jr., Research Engineer.	Vacuum-fusion method, NBS J. Research **7**, 375 (1931).
29. National Bureau of Standards, Washington, D. C. H. S. Rawdon, Chief, Division of Metallurgy; J. G. Thompson, H. C. Vacher, H. A. Bright & J. S. Sterling.	Vacuum-fusion method, NBS J. Research **7**, 375 (1931); Hydrochloric acid residue method, *ibid* **9**, 615 (1932); Iodine method of Cooperator No. 13.
30. War Department, Watertown Arsenal, Watertown, Mass. G. F. Jenks, Colonel, Ordnance Dept., U. S. A., Comd. Officer; A. Sloan, P. R. Kosting, & M. B. Gruzdis.	Iodine method of Cooperator No. 13. Electrolytic method of Cooperator No. 3.
31. National Physical Laboratory, Teddington, England. C. H. Desch, Superintendent, Metallurgy Department.	Iodine method of Rooney and Stapleton, J. Iron Steel Inst. **131**, 249 (1935); Vacuum-fusion method, Sloman, Iron Steel Inst., 6th Rept. of the Heterogeneity of Steel Ingo (1935) sec. 4, 71.
32. Central Institute of Metals, Leningrad, U. S. S. R. B. Selivanoff, General Scientific Manager; Gr. Weinberg, Metallurgist; & M. Janowsky, Chief, Chemical Labs.	Hydrogen-reduction method, Rept. of the Central Inst. of Metals **18**, 449 (1935).
33. Illinois Steel Co., Chicago, Ill. M. A. Grossman, Director of Research; and Miss M. Baeyertz.	Microscopical examination.
34. Institut für Eisenhüttenkunde der Technischen Hochschule, Aachen, Germany. W. Eilender, Director.	Vacuum-fusion method, graphite-spiral furnace.

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