

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 1228

Basic Open-Hearth Steel, 0.1% Carbon

(In cooperation with the American Society for Testing and Materials)

This Standard Reference Material is in the form of disks approximately 32 mm (1 1/4 in) in diameter and 19 mm (3/4 in) thick, intended for use in optical emission and x-ray spectrometric methods of analysis.

Constituent	C	Mn	P	S	Si	Cu	Ni	Cr	V	Mo	TOTAL Al
Certified ¹ Value, % by wt.	0.072	0.365	0.004	0.018	0.007	0.012	0.018	0.016	<0.001	0.009	0.061
Estimated ² Uncertainty	0.002	0.003	0.001	0.001	0.001	0.002	0.001	0.001	-----	0.001	0.003
Method	Combustion- Infrared	Peroxydisulfate- Arsenite	Photometric	Combustion- Infrared	Perchloric Acid Dehydration	Atomic Absorption	Atomic Absorption	Atomic Absorption	Atomic Absorption	Atomic Absorption	
Labs											
A	0.073	0.367	^a 0.004	0.018	0.007	0.014	0.018	0.017	<0.001	0.009	0.062
B	.074	^b .365	^c .005	.019	^a .007	.011	.018	.016	< .001	.010	.063
C	.070	^d .368	^a .004	.019	.006	^e .012	.019	^f .016	-----	^g .008	^h .058
D	.070	.361	^a .004	.018	ⁱ .007	^j .013	^k .017	^f .017	^l < .001	^g .010	^m .061 ⁿ .062

¹The certified value listed for a constituent is the *present best estimate* of the "true" value based on the results of the cooperative program for certification.

²The estimated uncertainty listed for a constituent is based on judgment and represents an evaluation of the combined effects of method imprecision, possible systematic errors among methods, and material variability. (No attempt was made to derive exact statistical measures of imprecision because several methods were involved in the determination of most constituents.)

Metallurgical Condition: The structure of the specimens is that resulting from hot working, followed by annealing.

^a Molybdenum blue photometric

^b Atomic absorption

^c Alkalimetric

^d Periodate photometric

^e Neocuproine photometric

^f Chromium separated from the bulk of the iron in a 10-g sample by hydrolytic precipitation with NaHCO₃, oxidized with persulfate and titrated with FeSO₄-K₂Cr₂O₇

^g Photometric

^h Eriochrome cyanine R photometric

ⁱ Double dehydration with intervening filtration

^j Diethyldithiocarbamate photometric

^k Weighed as nickel dimethylglyoxime

^l Vanadium separated as in (f), oxidized with HNO₃, and titrated potentiometrically with ferrous ammonium sulfate

^m D.C. Plasma emission spectroscopy

ⁿ Optical emission spectroscopy

The overall coordination of the technical measurements leading to certification was performed under the direction of J.I. Shultz, Research Associate, ASTM-NBS Research Associate Program.

The technical and support aspects involved in the preparation, certification, and issuance of this Standard Reference Material were coordinated through the Office of Standard Reference Materials by R.E. Michaelis and W.P. Reed.

PLANNING, PREPARATION, TESTING, ANALYSIS:

The material for this standard was provided by the Bethlehem Steel Corporation, Bethlehem, Pa. Billets were fabricated at the Puget Sound Naval Shipyard, Bremerton, Washington, where they were forged to slabs and portions of questionable homogeneity were cut and discarded. The remaining slab sections were forged and swaged to rods (oversize 32 mm in diameter). The rods were given in sub-critical anneal, and were then centerless ground to the final size of 32 mm in diameter. Extensive homogeneity testing was performed in the Inorganic Analysis and Research Division at NBS; optical emission spectrometry by J.A. Norris and carbon/sulfur analysis by B.I. Diamondstone. Additional gravimetric and spectrometric analyses were carried out by R.K. Bell, Assistant Research Associate, ASTM/NBS Research Associate Program.

Cooperative analyses for certification were performed in the following laboratories:

Bethlehem Steel Corporation, Homer Research Laboratories, Bethlehem, Pa., D.A. Flinchbaugh and J.L. Fernandez.

Jones & Laughlin Steel Corporation, Youngstown, Ohio, L.E. Chalker.

Kaiser Steel Corporation, Steel Manufacturing Group, Fontana, California, C. B. Jenkins and R. Bell.

National Bureau of Standards, Inorganic Analytical Research Division, B.I. Diamondstone, M.S. Epstein, and R.K. Bell.