

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 1227

Basic Open-Hearth Steel, 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.

Element	Certified Value, ¹ % by wt.	Estimated Uncertainty ^{2,3} % by wt.
Carbon	0.97	0.01
Manganese	.402	.007
Phosphorus	.014	.003
Sulfur	.026	.002
Silicon	.215	.004
Copper	.006	.002
Nickel	.007	.001
Chromium	.019	.003
Vanadium	.002	.001
Molybdenum	.003	.001
Cobalt	.003	.001

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 gross sample variability ($\geq 1g$). (No attempt was made to derive exact statistical measures of imprecision.)

³Some heterogeneity, especially for carbon, was observed using optical emission methods of analysis. It is thought that these heterogeneities are associated with the small amount of material examined during each exposure. If the SRM user employs a similar technique using small portions of the SRM, ($\ll 0.1g$), then sample variability similar to that shown in the table on the reverse side may be observed. The total uncertainty should include both the uncertainty due to the certified value and the uncertainty due to using a small sample.

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

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.

The emission spectrochemical homogeneity testing results showed inhomogeneity for carbon. The standard deviations determined from 240 exposures on 15 specimens are:

<u>Element</u>	<u>Standard Deviation</u>
Carbon	0.021
Manganese	.008
Phosphorus	.0008
Sulfur	.0024
Silicon	.0033
Copper	.00056
Nickel	.00013
Chromium	.00047
Vanadium	.00009
Molybdenum	.00017
Cobalt	.00016

Other elements present whose values are *not certified*:

Titanium	(.0008%)
Aluminum	(.028%)
Zirconium	(.0006%)

PLANNING, PREPARATION, TESTING, ANALYSIS:

The material for this standard was provided by the United States Steel Corporation, Gary Works, Gary, Indiana. 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 a 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 Analytical Research Division at NBS; optical emission spectrometry by J.A. Norris and carbon/sulfur analysis by B.I. Diamondstone.

Additional gravimetric and spectrophotometric 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, Sparrows Point Plant, Sparrows Point, Maryland; F.T. Kowalczyk.

Ford Motor Company, Central Laboratory Services, Northville, Michigan; D.H. Craig, J. Pinner, and C. Holda.

National Bureau of Standards, Inorganic Analytical Research Division, B.I. Diamondstone, and by R.K. Bell, ASTM-NBS Research Associate Program.

Phoenix Steel Corporation, Claymont, Delaware; J.A. Crawley.

Sharon Steel Corporation, Sharon, Pennsylvania; N.J. Williams.