



# National Institute of Standards & Technology

## 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 (SRM) is in the form of disks approximately 32 mm (1 1/4 in) in diameter and 19 mm (3/4 in) thick. It is intended for use in optical emission and X-ray spectrometric methods of analysis.

| Element          | Certified Value <sup>1</sup><br>wt %* | Estimated <sup>2</sup><br>Uncertainty |
|------------------|---------------------------------------|---------------------------------------|
| Carbon           | 0.072                                 | 0.002                                 |
| Manganese        | 0.365                                 | 0.003                                 |
| Phosphorus       | 0.004                                 | 0.001                                 |
| Sulfur           | 0.018                                 | 0.001                                 |
| Silicon          | 0.007                                 | 0.001                                 |
| Copper           | 0.012                                 | 0.002                                 |
| Nickel           | 0.018                                 | 0.001                                 |
| Chromium         | 0.016                                 | 0.001                                 |
| Vanadium         | <0.001                                | ----                                  |
| Molybdenum       | 0.009                                 | 0.001                                 |
| Aluminum (total) | 0.061                                 | 0.003                                 |

<sup>1</sup>The 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.

<sup>2</sup>The 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 for samples 0.5 g or more. (No attempt was made to derive exact statistical measures of imprecision because several methods were involved in the determination of most constituents.)

\*wt % = mg/kg x 10<sup>-4</sup>

*This Certificate of Analysis has undergone editorial revision to reflect program and organizational changes at NIST and at the Department of Commerce. No attempt was made to reevaluate the certificate values or any technical data presented on this certificate.*

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

The technical and support aspects involved in the original preparation, certification, and issuance of this SRM were coordinated through the Standard Reference Materials Program by R.E. Michaelis. Revision of this certificate was coordinated through the Standard Reference Materials Program by P.A. Lundberg.

Gaithersburg, MD 20899  
June 25, 1993  
(Revision of certificate dated 9-28-82)

Thomas E. Gills, Acting Chief  
Standard Reference Materials Program

(over)

## **PLANNING, PREPARATION, TESTING, ANALYSIS:**

The material for this standard was provided by the Bethlehem Steel Corp., Bethlehem, PA. Billets were fabricated at the Puget Sound Naval Shipyard, Bremerton, WA, 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 NIST; optical emission spectrometry by J.A. Norris and carbon/sulfur analysis by B.I. Diamondstone. Additional gravimetric and spectrometric analyses were performed by R.K. Bell, Assistant Research Associate, ASTM-NIST Research Associate Program.

Cooperative analyses for certification were performed in the following laboratories:

Bethlehem Steel Corp., Homer Research Laboratories, Bethlehem, PA, D.A. Flinchbaugh and J.L. Fernandez.

Jones & Laughlin Steel Corp., Youngstown, OH, L.E. Chalker.

Kaiser Steel Corp., Steel Manufacturing Group, Fontana, CA, C.B. Jenkins and R. Bell.

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