



# National Institute of Standards & Technology

## Certificate of Analysis

### Standard Reference Material® 5m

#### Cast Iron

(In Cooperation with ASTM)

This Standard Reference Material (SRM) is intended primarily for use in chemical methods of analysis. One unit of SRM 5m consists of 150 g of material in the form of chips sized between 0.50 mm and 1.40 mm sieve openings (35 mesh and 14 mesh, respectively).

The certified concentration values, expressed as mass fractions [1], for 12 elements are listed in Table 1. The analytical methods used for characterization of this SRM are listed in Table 2.

Table 1. Certified Mass Fractions

Element	(%)	Element	(%)
Carbon	2.59 ± 0.04	Nitrogen	0.006 ± 0.001
Chromium	0.080 ± 0.004	Phosphorus	0.32 ± 0.02
Copper	0.89 ± 0.03	Silicon	1.83 ± 0.04
Manganese	0.74 ± 0.03	Sulfur	0.133 ± 0.004
Molybdenum	0.029 ± 0.003	Titanium	0.097 ± 0.008
Nickel	0.041 ± 0.002	Vanadium	0.033 ± 0.001

The uncertainties listed above, are expressed as “combined uncertainties” calculated according to the ISO Guide [2]. Each uncertainty is based on the 95 % confidence limit of the “true value”, and is intended to represent the combined effect of uncertainty components associated with various analytical factors, such as method imprecision, possible systematic errors among methods, and material variability.

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

Statistical analysis was provided by L.M. Gill of the NIST Statistical Engineering Division.

The technical and support aspects involved in the preparation, certification, and issuance of this SRM were coordinated through the Standard Reference Materials Program by P.A. Lundberg and C.M. Beck II.

Gaithersburg, MD 20899  
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Standard Reference Materials Program

Table 2. Analytical Methods Used

Element	Methods
Carbon	COMB-IR
Chromium	DCP, ICPOES, TITR
Copper	DCP, ICPOES, MAS
Manganese	DCP, ICPOES, TITR
Molybdenum	DCP, ICPOES, MAS
Nickel	DCP, FAAS, ICPOES
Nitrogen	COMB-TC
Phosphorus	DCP, ICPOES, TITR
Silicon	GRAV, FAAS
Sulfur	COMB-IR
Titanium	DCP, ICPOES, MAS
Vanadium	DCP, FAAS, ICPOES

### Methods

COMB-IR	Combustion-infrared detection
COMB-TC	Combustion-thermal conductivity
DCP	Direct current plasma atomic emission spectrometry
FAAS	Flame atomic absorption spectrometry
GRAV	Gravimetry
ICPOES	Inductively coupled plasma optical emission spectrometry
MAS	Molecular absorption spectrometry (spectrophotometry)
TITR	Titrimetry

### PLANNING, PREPARATION, TESTING, AND ANALYSIS

The material for this SRM was prepared at the American Cast Iron Pipe Co., Birmingham, AL.

Homogeneity testing was performed at the American Cast Iron Pipe Company, Birmingham, AL by D.R. Denney and R.J. Huffman.

Cooperative analyses for certification were performed in the following laboratories:

American Cast Iron Pipe Co., Birmingham, AL; D.R. Denney, R.T. Kirkland, R.G. Moffett, R.J. Huffman, J. Hudson, A. Jackson, and J. Atwell.

Armco Advanced Materials Co., Butler, PA; E.A. Nowacki, G.K. Ripper.

Elkem Development Center, Sewickley, PA; D. Cescon and E.J. Battif.

Armco Research and Technology, Middletown, OH; H.P. Vail.

LTV Steel Co., East Chicago, IN; J.M. Hlebek.

### REFERENCES

- [1] Taylor, B.N., "Guide for the Use of the International System of Units (SI)," NIST Special Publication 811, 1995 Ed., (April 1995).
- [2] *Guide to the Expression of Uncertainty in Measurement*, ISBN 92-67-10188-9, 1st Ed. ISO, Geneva, Switzerland, (1993); see also Taylor, B.N. and Kuyatt, C.E., "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results," NIST Technical Note 1297, U.S. Government Printing Office, Washington, D.C., (1994).