

National Bureau of Standards

Certificate of Analysis

Standard Reference Material C 1289

High-Alloy Steel, ACI CA-6NM (AISI 414 Mod.)

In cooperation with
American Society for Testing and Materials
and
Steel Founders' Society of America

This SRM is in the form of disks 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
Carbon	0.014	0.001
Manganese	.35	.01
Phosphorus	.017	.004
Sulfur	.021	.002
Silicon	.156	.005
Copper	.205	.005
Nickel	4.13	.01
Chromium	12.12	.01
Vanadium	0.007	.001
Molybdenum	.82	.01
Cobalt	.035	.004
Titanium	.005	.001
Lead	.0005	.0001

1. 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.
2. 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. (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 specimens were chill cast by a rapid unidirectional solidification technique.

CERTIFIED PORTION: The certified portion for each specimen is that extending upward 16 mm (5/8 in) from the chill cast or test surface (the largest surface opposite the numbered surface). This portion only was analyzed in the cooperative program for certification.

The overall coordination of the technical measurements leading to certification was performed under the direction of J. 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.

PLANNING, PREPARATION, TESTING, ANALYSIS:

The material for this SRM was melted and cast at Esco Corporation, Portland, Ore., (L. E. Finch), under an NBS contract with the Steel Founders' Society of America (SFSA). A water-cooled, copper-plate mold assembly made by Esco for the SPSA was used in the preparation of the chill castings. The preparation and plan for homogeneity testing was similar to that described in NBS Misc. Publ. 260-1, Standard Reference Materials: Preparation of NBS White Cast Iron Spectrochemical Standards, R. E. Michaelis and L. L. Wyman, June 19, 1964.

Extensive homogeneity testing was carried out at NBS by metallographic studies, C. H. Brady; by optical emission analysis, J. A. Norris; by x-ray fluorescence analysis, P. A. Pella; and by R. K. Bell, ASTM/NBS Assistant Research Associate. Composite samples for chemical analyses were prepared in the form of millings cut from the certified portion of representative specimens of the lot of chill castings.

Cooperative analyses for certification were performed in the following laboratories:

Allegheny Ludlum Steel Corporation, Brackenridge, Pa., A. I. Fulton and C. W. Hartig.

Carpenter Technology Corporation, Reading, Pa., T. R. Dulski and E. J. Cramer.

Colt Industries, Crucible Research Center, Pittsburgh, Pa., G. L. Vassilaros; Alloy Division, Midland, Pa., J. Davelli; and Specialty Metals Division, Syracuse, N.Y., R. Wlodarczyk.

Lukens Steel Company, Coatesville, Pa., J. H. Morris.

National Bureau of Standards, Inorganic Analytical Research Division, C. Blundell, T. Butler, E. R. Deardorff, B. I. Diamondstone, M. Epstein, S. Hanamura, J. Messman, T. C. Rains, and T. A. Rush.

Elements other than those certified are present in this material as indicated below. These are *not certified*, but are given as additional information on the composition.

<u>Element</u>	<u>Concentration % by weight</u>
Aluminum	(0.0016)
Niobium	(.10)
Zirconium	(.001)
Nitrogen	(.017)
Oxygen	(.027)

NBS Standard Reference Materials
 High-Alloy Steel Series
 June 25, 1981
 R. E. Michaelis, NBS Office of Standard Reference Materials
 and
 J. I. Shultz, ASTM Research Associate

The following table gives the values for three chill-cast high alloy steel SRM's. The SRM's are available in the form of disks, approximately 32 mm (1 1/4 in) in diameter and 19 mm (3/4 in) thick for use in optical emission and x-ray spectrometric methods of analysis. These SRM's are being issued as a result of a major Industry-SFSA-ASTM-NBS cooperative program.

SRM No.	C1287	C1288	C1289
Designation	ACI HK (AISI 310 Mod.)	ACI CN-7M (A743)	ACI CA-6NM (AISI 414 Mod.)
Carbon	0.36	0.056	0.014
Manganese	1.66	.83	.35
Phosphorus	0.029	.023	.017
Sulfur	.024	.010	.021
Silicon	1.66	.41	.156
Copper	0.58	3.72	.205
Nickel	21.16	29.3	4.13
Chromium	23.98	19.55	12.12
Vanadium	0.09	0.086	0.007
Molybdenum	.46	2.83	.82
Cobalt	.31	0.10	.035
Titanium	.050	.012	.005
Lead	.008	.0041	.0005
Aluminum	(.06) ^a	(.0025) ^a	(.0016) ^a
Niobium	(.07)	(.22)	(.10)
Nitrogen	(.034)	(.028)	(.017)
Oxygen	(.017)	(.029)	(.027)
Zirconium	(.006)	(.002)	(.001)
Iron, by diff.	(49.45)	(42.68)	(81.97)

^aValues in parenthesis are not certified.

The value listed for a certified constituent is the *present best estimate* of the "true" value based on the results of the analytical program for certification. The individual certificates of analysis list the "estimated uncertainties" associated with the certified values.

Inquiries regarding the chill-cast high-alloy steel SRM's C1287-C1289 should be directed to the Office of Standard Reference Materials, Chemistry Building, B311, National Bureau of Standards, Washington, D.C. 20234 (301) 921-2045.

Washington, D.C. 20234
 July 10, 1981

George A. Uriano, Chief
 Office of Standard Reference Materials