U. S. Department of Commerce
Malcolm Baldrige
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material C2401

High-Alloy Steel, (ACI-CD-4M Cu)

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

This Standard Reference Material (SRM) is in the form of a disk 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	0.062	0.001
Manganese	1.03	.01
Phosphorus	0.025	.001
Sulfur	.027	.002
Silicon	.74	.04
Copper	3.17	.09
Nickel	5.46	.02
Chromium	25.1	.1
Vanadium	0.20	.01
Molybdenum	2.13	.09
Cobalt	0.19	.01

[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.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.

Gaithersburg, MD 20899
February 19, 1986

Stanley D. Rasberry, Chief
Office of Standard Reference Materials

PLANNING, PREPARATION, TESTING, ANALYSIS:

The material for this SRM was melted and cast at Esco Corporation, Portland, Ore. A water-cooled, copper-plate mold assembly was used in the preparation of the chill castings.

Extensive homogeneity testing was carried out at NBS 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, C.W. Hartig and R. Chybrzynski.

Universal-Cyclops Speciality Steel Division, Bridgeville Plant, Bridgeville, Pa., F.F. Liberato.

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

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.

Element	Concentration % by weight
Aluminum	(<0.01)
Boron	(.0004)
Niobium	(.002)
Titanium	(<.005)
Tungsten	(.18)